781A TIME-MARK GENERATOR

Instruction Manual

Serial No. 5479 A234

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FAIRCHILD

DU MONT LABORATORIES

DIVISIONS OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

MP MASTER

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TYPE

781A TIME-MARK GENERATOR

Instruction Manual

Serial No. 5479 A234

FAIRCHILD

INSTRUMENTATION

A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

SCIENTIFIC INSTRUMENT DEPARTMENT

750 Bloomfield Avenue, Clifton, New Jersey, U.S.A.

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Manual No. 6704 2933

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ADDENDUM

FOR

TYPE 781A TIME MARK GENERATOR
(Reference Manual Part No. 6704 2933)

A. PURPOSE

The following change was made to correct performance specifications.

B. TEXT REVISIONS

1. In Section 1 Technical Summary make the following changes in Table of Specifications. Under "Impedance for Half Voltage" heading change 390 ohms or less and 600 ohms or less to read 390 ohms (nominal) and 600 ohms (nominal) respectively.

2. In Section 4 Performance Assurance Test under paragraph 4-6 change reference 15 volts minimum etc. to 13 volts.

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ADDENDUM

FOR

TYPE 781A TIME MARK GENERATOR
(Reference Manual Part No 6704 2933)

A. PURPOSE

The following changes were made to improve pulse shape.

B. PARTS LISTS REVISIONS

In Section 6A delete the following components from the Parts List and associated pictorial for the Modular Cards stated below.

Card No.	Figure No.	Delete Components
2102	6-3	C6, C7, C14, C15
2103	6-4	C6, C7, C14, C15
2104	6-5	C6, C7, C14, C15
2105	6-6	C6, C7, C14, C15
2106	6-7	C6, C7, C14, C15
2107	6-8	C6, C7

C. SCHEMATIC REVISIONS

1. Delete Reference Designations and associated values for C6, C7, C14 and C15 from the following schematics

Schematic Title	Sheet No.	Card No.
50 uSEC & 100 uSEC	2 of 12	2102
0.5 mSEC & 1 mSEC	3 of 12	2103
5.0 mSEC & 10 mSEC	4 of 12	2104
50 mSEC & 100 mSEC	5 of 12	2105
500 mSEC & 1 SEC	6 of 12	2106

2. On Schematic "5 SEC & TRIG BUFFER", Sheet 7 of 12 delete Ref Desig & associated value for C6 & C7 only.

D. TEXT REVISIONS

In Paragraph 5-5 "Checking the Power Supplies" change steps (2) and (3) voltage ranges to as follows:

From	To
112V to 128V	108V to 132V
6.3V to 7.7V	6.4V to 7.8V

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ADDENDUM

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(Reference Manual Part No 6704 2933)

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Card No.	Figure No.	Delete Components
2102	6-3	C6, C7, C14, C15
2103	6-4	C6, C7, C14, C15
2104	6-5	C6, C7, C14, C15
2105	6-6	C6, C7, C14, C15
2106	6-7	C6, C7, C14, C15
2107	6-8	C6, C7

C. SCHEMATIC REVISIONS

1. Delete Reference Designations and associated values for C6, C7, C14 and C15 from the following schematics

Schematic Title	Sheet No.	Card No.
50 uSEC & 100 uSEC	2 of 12	2102
0.5 mSEC & 1 mSEC	3 of 12	2103
5.0 mSEC & 10 mSEC	4 of 12	2104
50 mSEC & 100 mSEC	5 of 12	2105
500 mSEC & 1 SEC	6 of 12	2106

2. On Schematic "5 SEC & TRIG BUFFER", Sheet 7 of 12 delete Ref Desig & associated value for C6 & C7 only.

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From	To
112V to 128V	108V to 132V
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ADDENDUM

FOR

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SECTION 1
TECHNICAL SUMMARY

1-1. INTRODUCTION

Note: All references to the Type 781 in this Instruction Manual are also applicable to the Type 781A.

The Fairchild Type 781 Time-Mark Generator is a compact, transistorized portable instrument designed to provide accurate timing markers, trigger pulses, and sinusoidal output signals. This instrument may be used for testing oscilloscope time base calibration or in any application where precise quantitative analysis of time intervals is necessary.

1-2. FEATURES

The Time-Mark Generator is provided with 14 pulse intervals, 2 per decade, from 1 microsecond to 5 seconds. These marker intervals are:

1, 5, 10, 50, and 100 microseconds;
0.5, 1, 5, 10, 50, 100 and 500 milliseconds;
1 and 5 seconds.

Also available are 3 sine-wave frequencies of 5 Mc, 10 Mc, and 50 Mc. Accuracy is $\pm 0.005\%$ with a stability of 3 parts/million per day.

The marker outputs are available separately or in combination at the option of the user. Push-button switches are provided for the selection of the desired signal which is available at the MARKER OUT connector. Markers are also available individually at front-panel tip jacks. The MARKER OUT connector also serves as the output for the sine wave signal.

Positive triggering signals in decade steps from 1 cycle to 100 Kc are available from a front-panel TRIGGER OUT connector. These signals may be applied to the external trigger terminal of an oscilloscope or other external equipment.

1-3. TECHNICAL SUMMARY

The electrical characteristics of the Type 781 Time-Mark Generator are listed in the Performance Specifications which follow.

Figure 1-1. Type 781A Time-Mark Generator with Accessories Supplied

section 1 — technical summary

TYPE 781 PERFORMANCE SPECIFICATIONS

	BNC OUT JACKS (Selected by Push Button)				TIP JACKS		
	Output Terminated in 50Ω	Open Circuit Voltage	Impedance for Half-Voltage	Rise Time	Open Circuit Voltage	Impedance for Half-Voltage	Rise Time
MARKER PULSES	1 volt min.	4 volts min.	390 ohms or less	70 nanosecs at 1 μsec to 500 nanosec at 5 sec. Output terminated in 50Ω	26 volts min.	600 ohms or less	70 nanosecs at 1 μsec to 500 nanosecs at 5 seconds. Output terminated in 600 ohms
TRIGGER PULSES	5 volts min.	10 volts min.	50 ohms or less	80 nanosecs terminated in 50 ohms	——	——	——
SINE WAVE OUTPUT	3 volts min.	6 volts min.	50 ohms or less	——	——	——	——

CRYSTAL OSCILLATOR

Frequency

1 megacycle ±10 cps (±0.001%); may be precisely set for 1 Mc against WWV or other frequency standard

Stability

Within 3 parts per million in 24 hours. The 1 Mc crystal is mounted in a temperature-stabilized oven

POWER REQUIREMENTS

Line Voltage

From 105 to 125 volts or from 210 to 250 volts

Line Frequency

Operation from 48 through 1000 cycles

Power

21 watts average at 115-volt, 60-cycle line

MECHANICAL DIMENSIONS

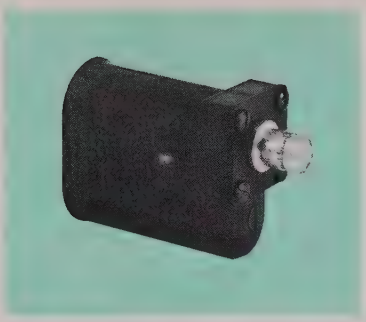
(Half rack universal package)

Height (includes feet) .....5¾" ..... (24.6 cm)
Width .....8½" ..... (21.6 cm)
Depth (includes handles and fuse) ....11⅞" ..... (30.2 cm)
Weight .....9.5 lbs ..... (4.3 kg)
Shipping Weight (approx.) .....15 lbs ..... (9 kg)

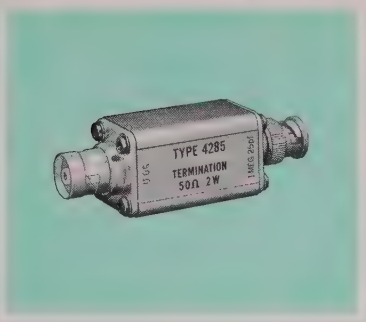
ACCESSORIES SUPPLIED

2 each: Type 7082 BNC to BNC jumper cable (42")

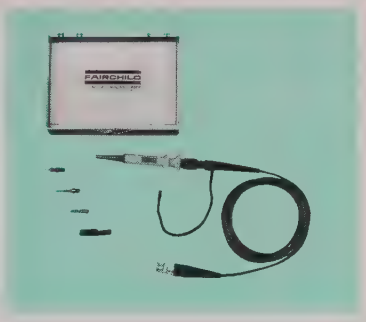
1 each: Power Cord Adapter



TYPE 2592-B
Shielded adapter connector; scope binding post to BNC



TYPE 4285A
50-ohm, 2-watt termination



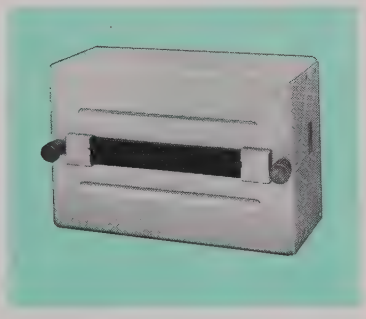
TYPE 4290
Attenuator Probe 10:1, 4′ cable

TYPE 7013
Recalibration Tool Kit

TYPE 7080
Scope BNC type to binding post adapter; UG-1090/U

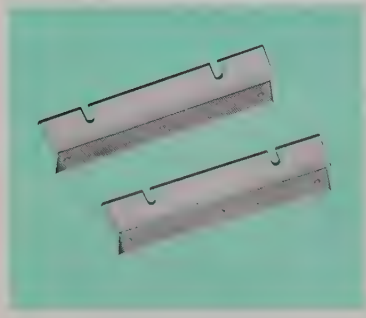
TYPE 7083
BNC to alligator clip jumper cable (42″)

TYPE 7093
5:1 50-ohm Attenuator

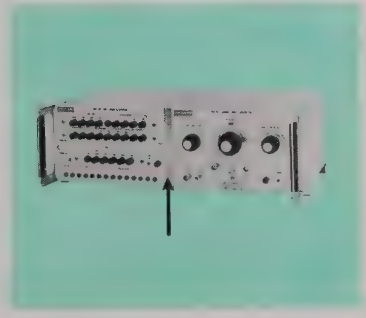


TYPE 7094
Protective Panel Cover for Type 781

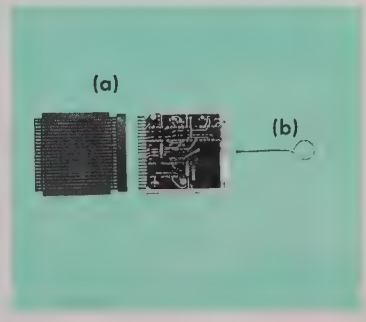
TYPE 7095
5-inch protective cover for full rack-mounting



TYPE 7096
Pair of rack-mounting ears



TYPE 7097 (arrow)
1/2-rack to full-rack mounting hardware



(a) Card Extender (#8700 1761)
(b) Card Puller (#6401 6621)

NOTES

SECTION 2
OPERATING INSTRUCTIONS

2-1. ENERGIZING THE EQUIPMENT

To place the Time-Mark Generator in operation, plug the power cord into the proper grounded power source and set the front-panel toggle switch to the POWER ON position. Allow approximately 15 minutes for the instrument to warm up. To minimize shock hazard, ground the unit. (A pigtail is provided on the power cord adapter plug for this purpose if a 3-wire receptacle is not available.)

2-2. 115V OR 230V OPERATION (Figure 2-1)

The Type 781 Time-Mark Generator can be operated from either a 115-volt or 230-volt primary power source. Selection of either voltage is accomplished as follows:

For 115-volt operation, insert key into J29-B and connect J29 to P29 on Z111.

Note: J29-A will be near the top of the unit.

For 230-volt operation, insert key into J29-E and connect J29 to P29 on Z111.

Note: J29-F will be near the top of the unit.

2-3. OPERATING HINTS (Figures 2-2 & 2-3)

a. Introduction

Numerous accessory components are available to extend the usefulness of this instrument. See Section 1 for a complete listing.

The following illustrations are designed to aid the operator in becoming familiar with the Time-Mark Generator.

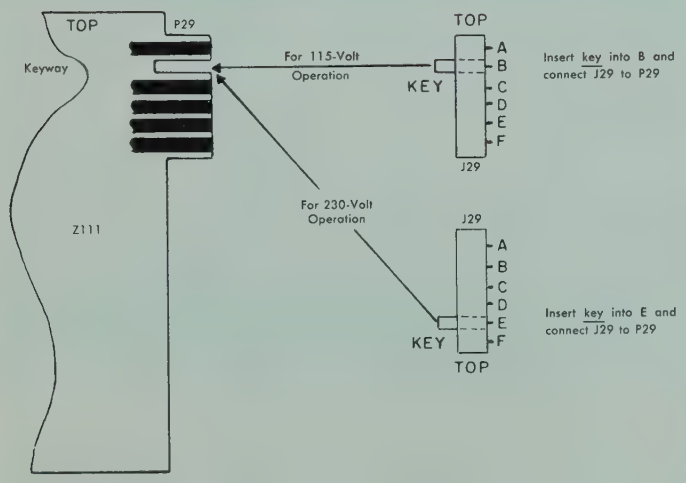
Figure 2-2. Front-Panel Facilities, Time-Marker System

Figure 2-3. Front-Panel Facilities, Primary Power and Trigger System

b. Timing Marker Outputs

The 14 time-marker intervals, 2 per decade, from 1 microsecond to 5 seconds are available separately or in any combination. These time-marker signals are applied to the MARKER OUT BNC front-panel connector by depressing the appropriate push-button switches.

A tip jack is provided for an additional output connector for each of the time-marker ranges. The marker signal appearing at the tip jack is independent of the operation of the push-button switch.



Note: 1. J29 is a small green connector.

2. Card Z111 is located at the right side of the unit when viewed from rear.

Figure 2-1.
115V/230V Operation

To disconnect a signal from the MARKER OUT BNC connector, depress the CANCEL *red* push-button switch. This procedure will disconnect all of the time-marker push-button switches. Then the operator may reconnect the desired time-marker signal to the MARKER OUT connector by depressing the appropriate push-button.

Three sine-wave outputs of 5, 10 and 50 megacycles are available at the MARKER OUT BNC connector. Each time you operate one of the sine-wave push-button switches, it will cancel all of the output signals previously selected and will override any time-marker push-button that may be depressed.

c. Trigger Out Signals

Six trigger rate frequencies of 1, 10, or 100 cycles or 1, 10, and 100 Kc are available separately from the TRIGGER OUT BNC front-panel connector. These TRIGGER OUT signals are selected by depressing the appropriate push-button switch. However, depressing the trigger push button for any one range will automatically cancel the range previously selected. Thus, only one range of trigger pulses is available at any one time. The trigger pulses are synchronous with their respective marker pulses.

Trigger pulses are made available to initiate the device under test at a multiple or submultiple frequency of the time-marker signal. For example, external triggering of an oscilloscope is simplified by the application of the Type 781 trigger pulses for the following displays:

(1) Viewing high repetition rate pulses (i.e. 50 Mc);
(2) observation of complex timing pulse markers; and
(3) checking sweep calibration at varying sweep recycling rates.

These trigger pulses may also be displayed to function as time-marker signals.

2-4. APPLICATIONS

The possible applications of the Type 781 Time-Mark Generator are many and varied. The time-marker signals are very useful for checking oscilloscope sweep linearity, for accurate calibration of sweeps, and for superposition of timing markers on the trace when making permanent photographic recordings.

Signal generators, counters, computers and other instruments producing repetitive phenomena can be quickly calibrated by a comparison of their output with the Type 781 output on an oscilloscope. Decade-frequency range switches may be rapidly and accurately checked in a similar manner.

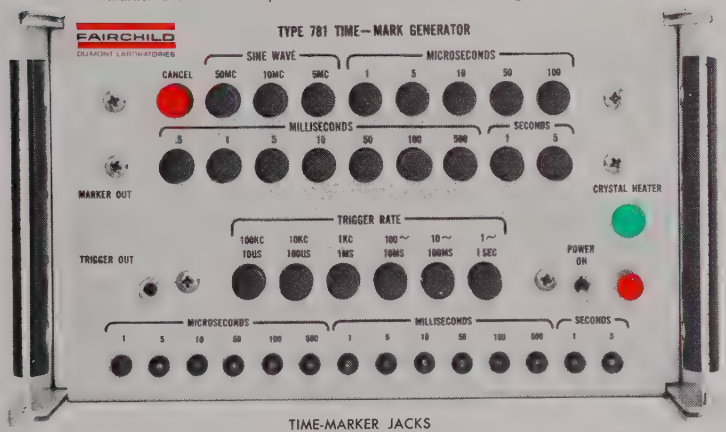
SINE WAVE & MARKER SELECTORS

17 black push-button switches (top 2 rows): 3 switches are provided for the selection of any one of 3 sine wave frequencies; 14 switches are provided for the selection of time-marker signals separately or in combination as indicated on the front panel. These signals are available at the MARKER OUT BNC connector by pushing the appropriate button.

Sine wave outputs are used independently of the marker outputs; therefore marker and sine wave push buttons should not be used together.

MARKER OUT

BNC connector: supplies precisely time positive output markers or sine wave signals as selected by push-button switches in the top 2 rows



CANCEL BUTTON

Red push-button switch mechanically releases all depressed buttons (in top 2 rows) thereby cancelling all time-marker and sine wave signals previously selected

TIME-MARKER JACKS

14 tip jacks (bottom row): 14 time-marker signals are available individually at these panel connectors and their output is independent of the activation of the front panel push-button switches.

Figure 2-2. Front-Panel Facilities, Time-Marker System

TRIGGER RATE SELECTOR

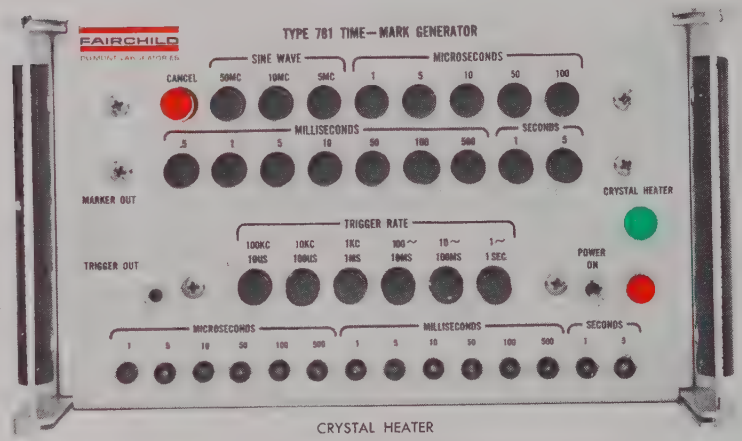
Six black push-button switches (2nd row from bottom): provide for the selection of any one of six triggering rate frequencies as indicated on the front panel. These signals are available at the TRIGGER OUT BNC connector by pushing the appropriate Trigger Rate button.

Depressing the trigger push button for any one range will automatically cancel the range previously selected. Thus, only one range of trigger pulses is available at any one time.

TRIGGER OUT

BNC connector: supplies positive pulses for triggering an oscilloscope or for the excitation of external equipment. These signals are selected by depressing the appropriate Trigger Rate push button.

These trigger pulses are synchronous with the marker pulses



POWER

Toggle switch: turns power on or off. Red indicator lamp lights on application of primary power

CRYSTAL HEATER

Green-colored lamp cycling on and off indicates operation of crystal heater. This heater unit is always operational when instrument is plugged into a live outlet and is independent of the on-off toggle switch setting.

Figure 2-3. Front-Panel Facilities, Primary Power & Trigger System

SECTION 3
CIRCUIT DESCRIPTION

3-1. INTRODUCTION

The timing circuits of the Type 781 are assembled on eleven printed wiring modules. Each printed wiring module is designed as a plug-in card that permits it to be easily removed for routine maintenance or for simple replacement. Each modular card is identified by a Z number. A simplified functional block diagram is shown in Figure 3-1.

3-2. MASTER OSCILLATOR (Card Z108)

In the discussion to follow, emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of this manual be referred to in following the circuit description.

All outputs of the Type 781 are derived from a 1 megacycle crystal-controlled oscillator which is temperature-stabilized to insure accurate crystal performance.

The oscillator Q1 is connected as a conventional Colpitts crystal-controlled oscillator. A front-panel amber-jeweled lamp DS2 is connected in parallel with the heating element to indicate operation of the thermostat. Trimmer capacitor C4 is connected in series with the crystal Y1 to permit slight adjustment of the crystal resonant frequency. Frequency stability is 3 parts per million over a 24-hour period.

The basic 1-megacycle output is coupled to amplifier Q2 before application to the first divider circuit modular card Z101; and to amplifier Q3 before application to the first multiplier circuit modular card Z109.

The time-marker signals are available individually at tip jacks, and separately or in combination at the MARKER OUT BNC connector. The sine-wave outputs are available one-at-a-time at the MARKER OUT connector. In addition, trigger signals are available individually at the TRIGGER OUT BNC connector. Refer to the Functional Block Diagram, Figure 3-1.

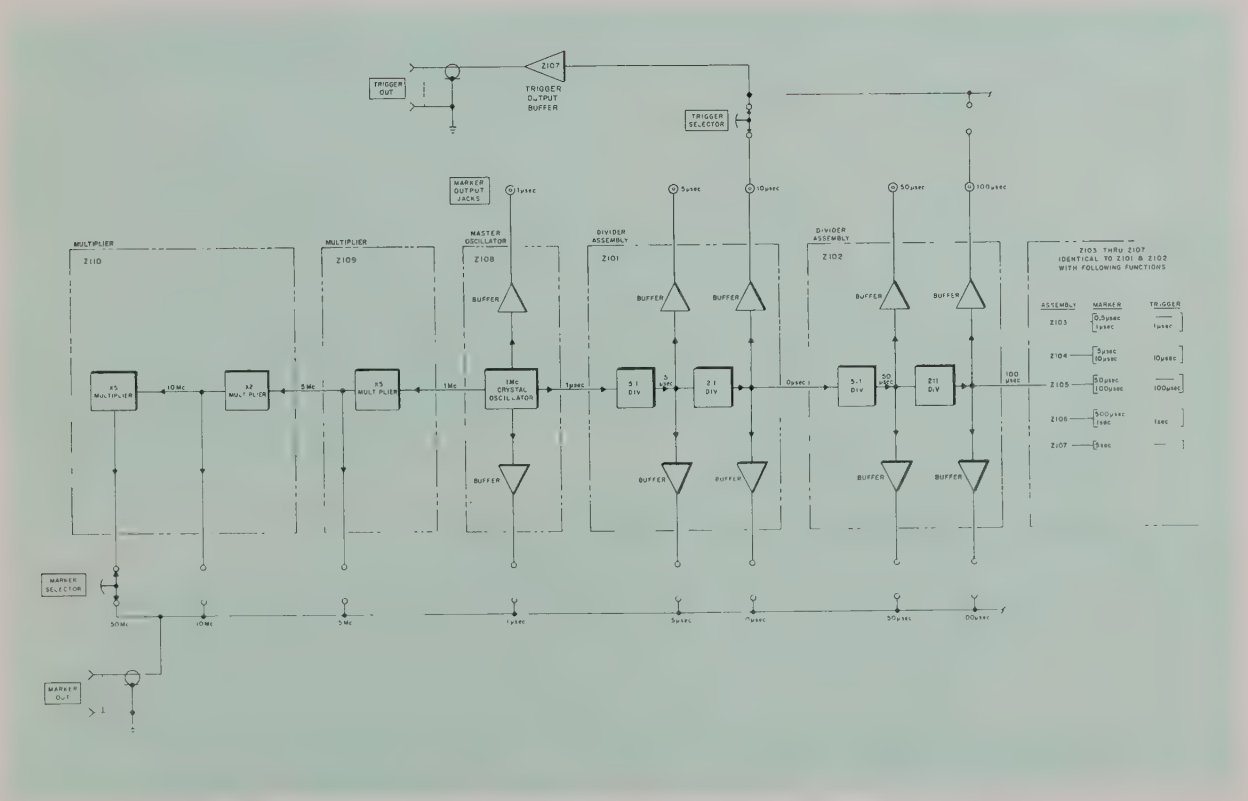


Figure 3-1. Type 781 Simplified Functional Block Diagram

3-3. SINE-WAVE MULTIPLIERS (Cards Z109 and Z110)

The 5 megacycle multiplier V1, located on card Z109, is a conventional grid-leak biased, Class C amplifier with its plate tank circuit tuned to 5 megacycles. The 1 Mc excitation pulse at the grid of V1, causes the tank circuit to resonate at its designed frequency of 5 megacycles. The 5 Mc sine-wave output is magnetically coupled from the tank circuit to the X2 multiplier (located on card Z110) and is also magnetically coupled to the Marker Selector push-button switch.

The other multipliers (10 Mc and 50 Mc outputs located on modular card Z110) operate in a similar manner, each stage obtaining its excitation signal from the preceding stage. All plate tanks are tuned above the grid tank frequency to achieve multiplication.

Sine-wave outputs of 5, 10 and 50 megacycles are available at the MARKER OUT connector, and are selected by push-button switches. The three sine-wave push-button selector switches are independently interlocked by a common latch bar so that by depressing one of the three buttons, it will automatically release the depressed button. Only one of these buttons may be depressed at a time. In other words, each time the sine wave push button is pushed in, all of the previously selected outputs will be cancelled and any time-marker push button that may be depressed will automatically be released.

3-4. TIME-MARKER DIVIDER (Cards Z101 to Z107)

a. General

There are 13 frequency dividers in the Type 781 yielding 13 of the 14 time-marker pulses. The fourteenth marker pulse is derived from the basic one-megacycle oscillator which serves as the master clock.

The frequency divider circuits are assembled on 7 printed wiring modular cards. All but one of the modular cards mount a 5:1 and a 2:1 divider. Each of these modules has similar layout and circuitry that differs only in choice of RC time constants. The odd modular card contains the 5-second time marker circuit and the trigger buffer amplifier.

b. 5:1 Divider Circuit Description (Figure 3-2)

Since the operation of the divider circuits are essentially similar, only the 5:1 divider circuit will be discussed in detail. Transistors Q1 and Q3 are connected as a monostable multivibrator which serves as a countdown circuit controlled by an RC timing network. Transistor Q2 serves as a high-speed charging emitter-follower source for timing capacitor C3.

In the quiescent state, transistor Q1 is fully conducting and Q2 is turned off. The multivibrator is

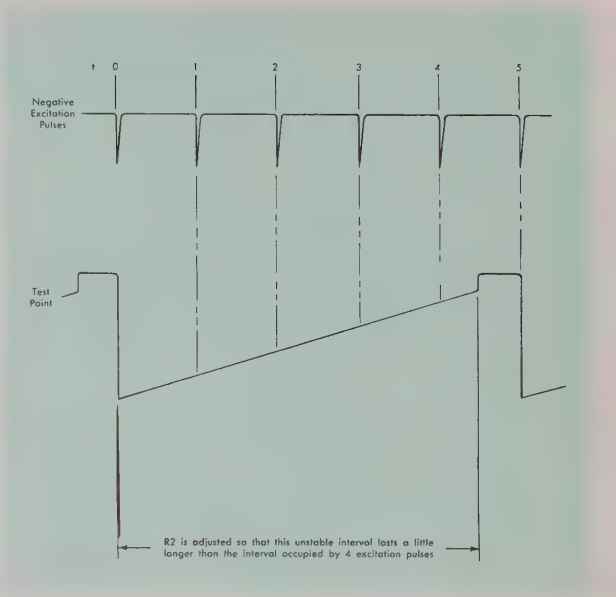


Figure 3-2. Display of 5:1 Count Down Waveform

triggered into its unstable state by the application of a negative trigger through the coupling diode CR2 to the base of Q1. Transistor Q1 is now turned off and Q3 is fully conducting. The multivibrator will temporarily remain in this state until the timing capacitor C3 discharges through R3 and R2 so that the base voltage of Q1 rises sufficiently to turn on Q1. Coupling diode CR2 cannot conduct under these conditions. Therefore, excitation pulses that might otherwise be applied cannot affect the multivibrator during the quasi-stable state.

For example, if we want the repetition frequency of the output pulses to be one-fifth the repetition frequency of the excitation pulses, R2 is adjusted so that the unstable interval lasts a little longer than the interval occupied by the four excitation pulses. Then the coupling diode CR2 permits only every fifth excitation pulse to be applied to the base of Q1 for initiation of the multivibrator for the 5:1 count down.

c. Derivation of Timing Signal for the Succeeding Stages

The negative pulse developed at the collector of Q3 is applied to a differentiated voltage-divider network consisting of C8 and R12 of which the latter is shunted by C11. This action yields negative and positive pips of which only the negative pip is of interest. The negative trigger now serves as the excitation signal for driving the succeeding frequency divider circuit. The trigger derived for starting the next chain of events is therefore time coincident with the initiating time-marker pulse. Thus, all of the other 13 fre-

quency-divider circuits will have their sync pulse essentially coincide with the initial marker derived from the 1 megacycle oscillator with minimal time delay. This delay generally will not exceed 2.5 microseconds in 5 seconds which represents a nominal phasing error of 5 parts in 10 million between the 1 microsecond clock and any marker or trigger pulse.

d. Buffer Stage

The negative pulse developed at the collector of Q3 is coupled to the buffer stage Q4. (This signal is transformer-coupled on the 5 μs and 10 μs divider and RC coupled for the remaining dividers; see schematics.) Transistor Q4 is connected as an amplifier. The 30-volt output is applied to the MARKER OUT pin jack on the front panel. The voltage divider consisting of R7 and C6, R8 and C7, produces the 5-volt, 390-ohm source pulses that are applied to the Marker Selector push-button switches on the front panel.

e. 2:1 Divider Circuit Description

The circuit configuration and operation of the 2:1 frequency divider is the same as the 5:1 circuit with one exception. Instead of generating one output pulse for every 5 input pulses, the 2:1 divider circuit produces one output pulse for every 2 input pulses. This technique is accomplished by the proper selection of the time constants R13, R14, and C12.

f. Trigger & Tip Jack Outputs

The 30-volt output from the 5:1 and 2:1 divider circuits are applied to (1) the MARKER OUT pin jack and (2) the TRIGGER RATE push-button switch. Each selected trigger pulse is applied to the trigger buffer Q6 and Q7 on card Z107 before it is coupled to the TRIGGER OUT connector on the front panel.

NOTES

SECTION 4
PERFORMANCE ASSURANCE TEST

4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance of the instrument. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 5, paragraph 5-4 for list of test equipment required.

NOTE

If this instrument is checked by a Receiving Inspection laboratory, the tests outlined below are recommended to certify performance. This instrument has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence, it is suggested that the certifying engineer try the recommended adjustments to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined below, the instrument will not perform to specification, the assistance of the local Fairchild Field Engineering representative should be requested.

4-2. WAVEFORM DATA

Photographs of the Trigger and Timing Marker outputs are shown in Figures 4-1 through 4-5. They were taken using a 50-ohm cable (RG-58/U) terminated in 50 ohms (Type 4285A) and connected to Type 765 Series Oscilloscope; dc to 50 Mc bandwidth. Both time and amplitude data is given.

4-3. CHECKING CRYSTAL OSCILLATOR

NOTE

Before making any adjustments, allow 60 minutes minimum for crystal oven to stabilize.

The frequency of the crystal oscillator is checked by connecting an Electronic Counter to the MARKER OUT connector and pressing the 1 microsecond push button. The oscillator frequency should be ± 10 cycles of its assigned frequency. Readjust C4 located on modular card Z108 for precisely 1 million cycles. The 1 Mc marker pulse should meet the following specifications:

Rise Time:	70 nanoseconds maximum into a 50-ohm system
Amplitude:	4 volts peak minimum open circuited, and 3 volts peak minimum when terminated with 390 ohms; 1 volt minimum into a 50-ohm system

4-4. CHECKING TRIGGER OUT SIGNAL (Figure 4-1)

Front panel push buttons are provided to connect any one of the six trigger outputs to the TRIGGER OUT connector. To check, connect the Test Oscilloscope to the TRIGGER OUT connector and press the appropriate TRIGGER RATE selector button.

The trigger signal should meet the following specifications:

Rise Time:	80 μsec maximum when trigger signal is terminated in 50 ohms
Output Voltage:	10 volts peak open circuited, and 5 volts peak minimum with 50-ohm termination

4-5. CHECKING MARKER OUT SIGNAL (Figures 4-2 to 4-4)

Time-marker signals are available for the following intervals:

1, 5, 10, and 100 microseconds;
0.5, 1, 5, 10, 50, 100, and 500 milliseconds;
1 and 5 seconds.

With a Test Oscilloscope connected to the MARKER OUT connector, press the appropriate Marker Selector push button to obtain the desired signal.

Note: Press the CANCEL button after each marker output selection if it is desired to obtain only one output signal at a time.

The Marker Signal should meet the following specifications:

Rise Time:	70 nanoseconds maximum at 1 μsec 500 nanoseconds maximum at 5 μsec
Amplitude:	4 volts peak minimum open circuited, and 3 volts peak minimum when terminated with 390 ohms; 1 volt minimum into a 50-ohm system

4-6. CHECKING SIGNAL AT MARKER TIP JACKS

The signal available at the marker tip front-panel jacks is checked on the Test Oscilloscope with a passive 10:1 Attenuator Probe attached.

The amplitude of the marker signal available at the tip jacks should measure 26 volts peak minimum and 15 volts minimum with 600-ohm termination.

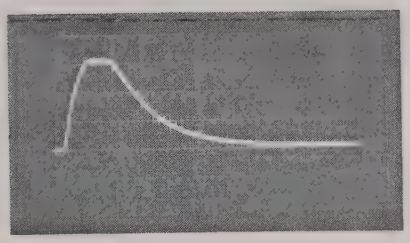
4-7. CHECKING SINE WAVE OUTPUTS (Figure 4-4)

The amplitude of the sine wave signals should be 3 volts peak-to-peak or greater with a 50-ohm load or 6 volts peak-to-peak or greater without a load.

4-8. EXAMPLES OF MARKER COMBINATIONS (Figure 4-5)

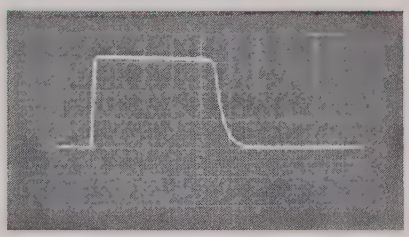
The individual push-button switches connect the markers to a common buss, so that any or all of the markers can be made available at the MARKER OUT BNC panel connector. Figure 4-5 illustrates the combination of 0.5, 1, and 5-millisecond markers.

10 μSEC



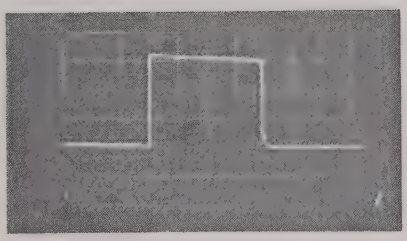
X = 0.2 μsec/div
Y = 2 volts/div

100 μSEC



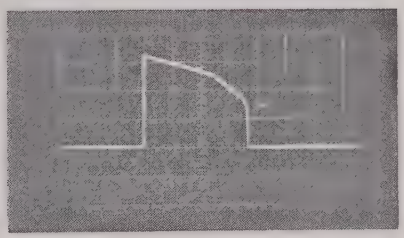
X = 1 μsec/div
Y = 2 volts/div

1 MSEC



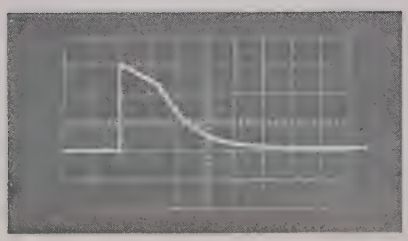
X = 5 μsec/div
Y = 2 volts/div

10 MSEC



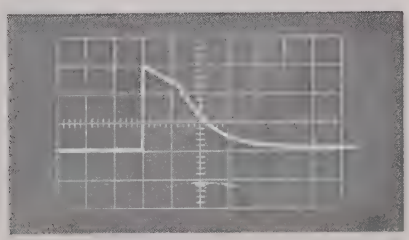
X = 50 μsec/div
Y = 2 volts/div

100 MSEC



X = 0.1 μsec/div
Y = 2 volts/div

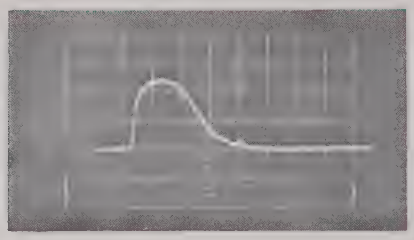
1 SEC



X = 0.1 msec/div
Y = 2 volts/div

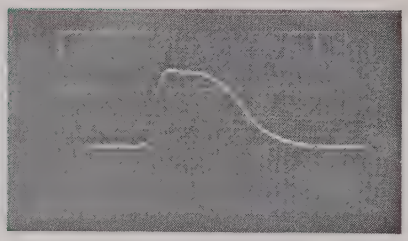
Figure 4-1. Type 781A Trigger Output Waveforms

1 MICROSECOND



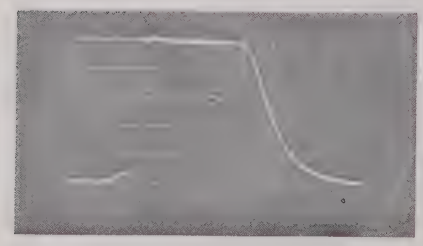
X = 0.1 μsec/div
Y = 0.5 volt/div

5 MICROSECONDS



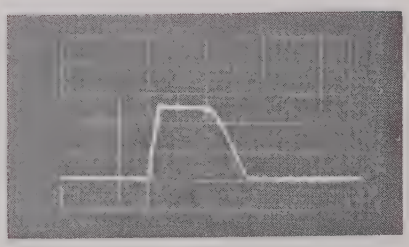
X = 0.05 μsec/div
Y = 0.5 volt/div

10 MICROSECONDS



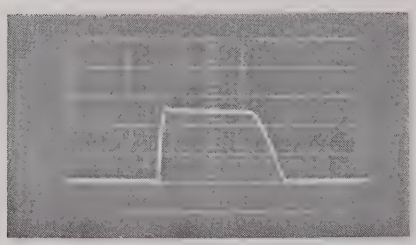
X = 0.1 μsec/div
Y = 0.25 volt/div

50 MICROSECONDS



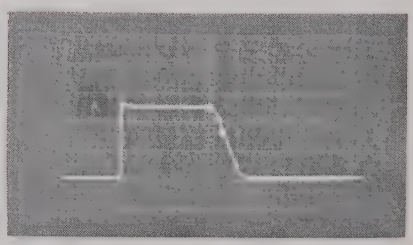
X = 1μsec/div
Y = 0.5 volt/div

100 MICROSECONDS



X = 1 μsec/div
Y = 0.5 volt/div

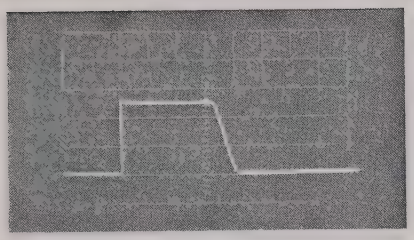
0.5 MILLISECOND



X = 5 μsec/div
Y = 0.5 volt/div

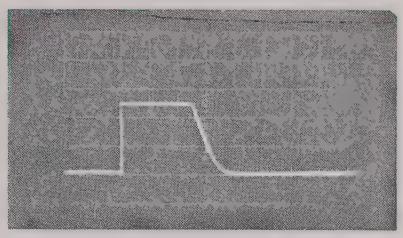
Figure 4-2. Type 781A Marker Output Waveforms

1 MILLISECOND



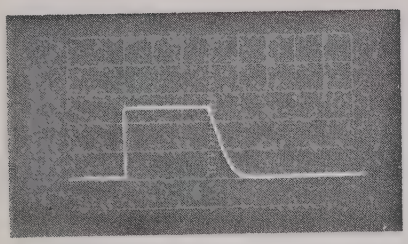
X = 5 μsec/div
Y = 0.5 volt/div

5 MILLISECONDS



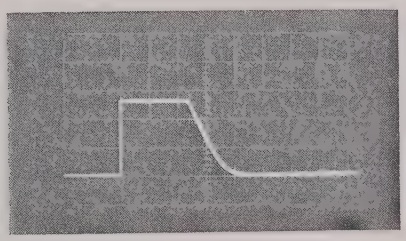
X = 50 μsec/div
Y = 0.5 volt/div

10 MILLISECONDS



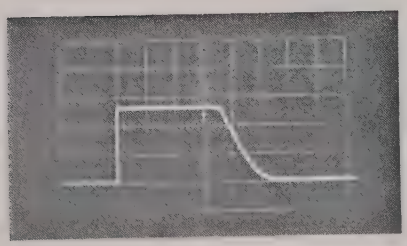
X = 50 μsec/div
Y = 0.5 volt/div

50 MILLISECONDS



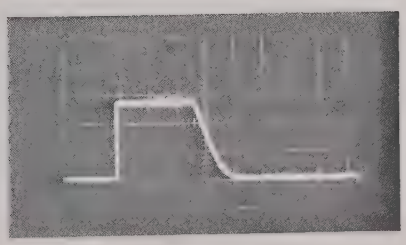
X = 0.5 msec/div
Y = 0.5 volt/div

100 MILLISECONDS



X = 0.5 msec/div
Y = 0.5 volt/div

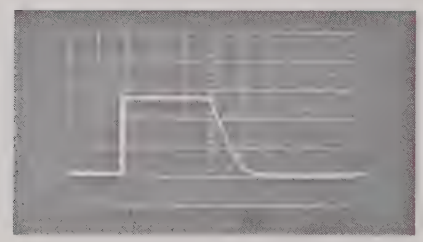
500 MILLISECONDS



X = 5 msec/div
Y = 0.5 volt/div

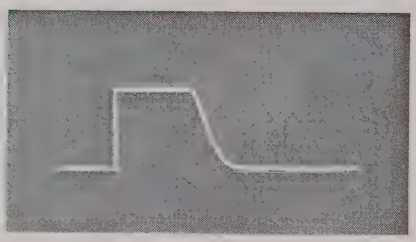
Figure 4-3. Type 781A Marker Output Waveforms

1 SECOND



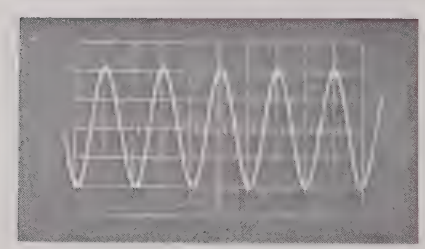
X = 5 msec/div
Y = 0.5 volt/div

5 SECONDS



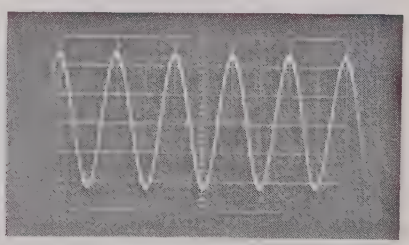
X = 5 msec/div
Y = 0.5 volt/div

5 MEGACYCLES



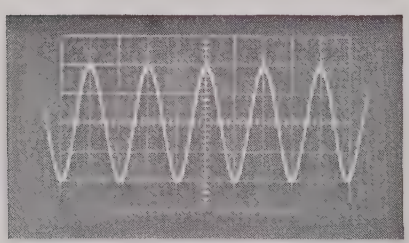
X = 0.1 μsec/div
Y = 1 volt/div

10 MEGACYCLES



X = 0.05 μsec/div
Y = 1 volt/div

50 MEGACYCLES



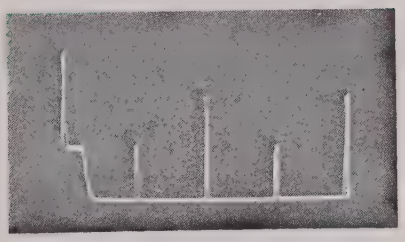
X = 0.01 μsec/div
Y = 1 volt/div

Figure 4-4. Type 781A Time Markers and Sine Wave Outputs

COMBINATION
0.5, 1 & 5 MILLISECONDS

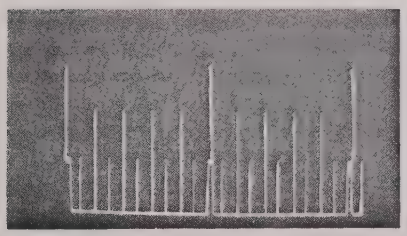
X = 0.2 msec/div
Y = 0.5 volt/div

COMBINATION
0.5, 1 & 5 MILLISECONDS



X = 0.5 msec/div
Y = 0.5 volt/div

COMBINATION
0.5, 1 & 5 MILLISECONDS



X = 1 msec/div
Y = 0.5 volt/div

Figure 4-5. Type 781A Marker Combinations

NOTES

SECTION 5
MAINTENANCE AND RECALIBRATION

5-1. INTRODUCTION

This Section of the Instruction Manual contains service information and procedures for internal adjustments.

5-2. REMOVAL AND REPLACEMENT OF PARTS

To gain access to the chassis for service, remove the rear panel. This will expose all of the plug-in modular cards and service adjustments for normal maintenance. The accessory Card Extractor (Part #6701 6621) may be used for pulling out the plug-in modular card and the accessory Card Extender (Part #8700 1761) makes possible the remote operation of the card assembly module.

With the power connector bracket in place, access to the right side of the unit (looking at the unit from the rear) will be limited. In order to gain the maximum working room, remove the power connector bracket by unscrewing 2 mounting screws which are on the side of the unit, and remount the bracket on the outside of the unit. This operation will allow complete access to the rear of the unit.

If it is necessary to order a replacement component from the factory, always give the Type Number and Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings, and the factory part number for all electrical components used in the instrument. This will help to expedite service. Entire modular card replacements are available and may be ordered as indicated in the Parts List in Section 6 of this manual.

Since your instrument left the factory, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from the factory and it has been superseded by an improved component, the new part will be shipped in place of the part ordered.

It is the aim of the Fairchild organization to make available the most reliable commercial instruments within the state of the art and to provide services which will help the user to rapidly restore any of our equipment to its specified performance. Your local Field representative maintains a limited number of spare parts and should be contacted for information. The factory may be asked to air-ship replacement parts on a rush basis.

The procedure for replacing most parts in this instrument is obvious, therefore specific instructions for their removal are not required.

5-3. SERVICING HINTS

Although this is a complex electronic instrument, troubles may be localized to the following basic circuits:

1. Regulated Power Supplies (Z111)
2. 1-Megacycle Master Oscillator (Z108)
3. Sine-Wave Multipliers (Z109 & Z110)
4. 5:1 and 2:1 Frequency Dividers (Z101 to Z107)
5. Marker and Trigger Selector Switches (Z112) and Trigger Buffer Amplifier on Z107

Whenever trouble occurs in this instrument, first try to localize it to one of these basic circuits.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help (refer to Circuit Description in Section 3). With an understanding of the circuits, you will be able to make a reasonable assumption at the general source of troubles from their symptoms.

As an aid in trouble-shooting this unit, refer to the simplified functional block diagram given in Figure 3-1, and of the schematics located at the rear of this manual.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush. However, to insure the reliability of measurements, we suggest that you check calibration of this instrument after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be fully checked and adjusted after the repair or replacement of any component in the unit. The complete adjustment procedure for this unit is given in this Section of the Instruction Manual.

In the event of improper equipment performance, the following suggestions are recommended:

1. If the instrument fails to operate including the pilot light, check the source of power and determine that the power cord is firmly in place. Check the fuses at the rear of the unit.

2. If the line voltage is within the specified limits, and one of the regulated power supply output voltages is not correct, check that particular regulator circuit.

3. If the pilot light and crystal oven lamps operate

but there is no trigger or time-marker output signals, check the 1-Megacycle Master Oscillator.

Note: The 1-Megacycle Module is the clock which controls all timing and that other modular cards stack in series sequence like links in a chain. If a fault develops in a single divider card, all following dividers will then be out of sync. Thus, a single fault can uncalibrate the following sequence output pulse.

4. Localizing the trouble is made easier by use of a Test Oscilloscope to check waveforms. These waveforms are shown at key points on the timing circuit cards Z101 to Z110. Both the waveform amplitude and time duration are given. Use a high-impedance 10:1 Passive Attenuator Probe while trouble shooting (Fairchild Type 765 Series Oscilloscope with a Y Plug-in having a bandwidth from dc to 50 Mc is recommended).

5. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks while soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended.

6. Be sure the troubles are *not* originating in the cables and accessories before suspecting the operation of the Type 781.

7. Referring to the schematic, Test Point TP1 on the appropriate modular card may be used for checking the 5:1 frequency divider circuits; and Test Point TP2 for the 2:1 frequency divider circuits.

8. Once the defective modular card has been localized, it may be extracted and attached to the Card Extender for remote operation. All components on the plug-in modular card will now be accessible.

9. Once the defective stage has been localized, the component (s) causing the trouble can be located by component substitution or by voltage and waveform measurements. In fact, the entire card assembly may be readily extracted and replaced. This procedure simplifies maintenance. Key voltage measurements are shown on the over-all schematics at the rear of this manual.

10. The identification of replaceable modular cards and replaceable components on modular cards Z101 to Z111 are shown in Section 6 of this Instruction Manual.

5-4. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. Introduction

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory.

The procedure outlined in this manual should be followed. The frequency dividers and multiplier circuits are factory aligned and should not be touched unless there is a positive indication that they require adjustment.

All adjustments should be made at mid-line voltage, 115V ±2%, and the unit warmed up for at least an hour.

b. Test Equipment Required (Equivalent may be substituted)

Equipment	Description
Volt-Ohmmeter	Simpson Model 260 20,000 ohms/volt sensitivity
Autotransformer	Powerstat, Variac; capable of varying line voltage of the instrument being calibrated
Differential Voltmeter	John Fluke Model 801
AC Voltmeter	Weston Model 433
Electronic Counter	Hewlett-Packard Model 524D
Oscilloscope with: Y Plug-in	Fairchild Type 766H Series Type 76-08 Dual Trace; dc 50 Mc
X Plug-in	Type 74-03A Time Base
Attenuator Probes	Fairchild Type 4290 10:1, 10 megohms, 10 pf input
Card Extractor (#6701 6621)	Tool for gaining access to the plug-in modular cards
Card Extender (#8700 1761)	For remote operation of the plug-in modular cards
Alignment Tools	Fairchild Type 7013 Tool Kit
50-ohm Termination	Fairchild Type 4285A
50-ohm, 5:1 Pad	Fairchild Type 7093

CAUTION

Always use insulated tools while working or making adjustments on the unit when power is on. The transistors in this instrument may be damaged if over-voltaged by accidental grounding of one or more elements. Exercise caution and turn off power when making repairs.

5-5. CHECKING THE POWER SUPPLIES

Connect the autotransformer to a suitable power source and connect the Time-Mark Generator to this transformer. Turn on the instrument and set the output for the nominal operating voltage of the instrument using the Weston Model 433 AC Voltmeter. Allow 60 minutes of warmup time before making any adjustments.

WARNING

WHEN THE PANELS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

On Card Z111, check the Supplies in the sequence listed with the Fluke Voltmeter.

(1) 30-volt regulated supply must read 27V to 33V
(2) 120-volt unregulated supply must read 112V to 128V
(3) 6-volt regulated supply must read 6.3V to 7.7V

Note: Voltage test points are labeled on the card.

5-6. CRYSTAL OSCILLATOR ALIGNMENT (Z108)

The timing circuits of the Type 781 are assembled on eleven printed wiring modules. Each printed wiring module is designed as a plug-in card that permits it to be easily removed for routine maintenance or for simple replacement. The function and location of each modular card and service adjustments are shown in Figure 5-4.

NOTE: All adjustments performed with the Test Oscilloscope are made with a passive 10:1 low-capacity attenuator probe attached.

1. Apply the Hewlett-Packard Model 524D Electronic Counter to the MARKER OUT connector with Type 7082 cable.

Note: The Electronic Counter should be certified against WWV or other primary frequency standard.

2. Depress the 1 μsec push button and adjust timing capacitor C4 (in series with the crystal) for a frequency reading of 10 million cycles, ±1 cycle in a 10-second gate period.

3. Connect the Type 781 MARKER OUT connector to a 50 Mc Oscilloscope through a Type 7082 cable terminated in 50 ohms (Type 4285).

The output signal will appear as a pulse with the following characteristics:

Output Voltage:	1 volt minimum into 50 ohms; 4 volts peak open circuited, and 3 volts peak minimum with 390-ohm termination
Rise Time:	70 nanoseconds maximum using 50-ohm termination

NOTE

If R9 on Card Z108 has to be replaced for maintenance purposes, it must be selected to obtain the proper waveshape. The proper waveshape for the 1μsec pulse at the time-marker output jack is shown in Section 4, Figure 4-2.
The nominal value of R9 is 2700 ohms. By selecting a value greater than 2700 ohms, the pulse width will tend to decrease and round out its top — the desired approach. Conversely, smaller values will increase pulse width and flatten its top — the undesirable approach.

5-7. ALIGNMENT OF THE 5 MC MULTIPLIER (Z109) (Figure 5-1)

1. Hook up Type 781 to a 50 Mc Test Oscilloscope as indicated in Figure 5-1.

2. Press the 1 microsecond push button. The frequency of the displayed signal has been previously checked (in the crystal oscillator test) and is 1 megacycle.

3. Adjust the sweep rate of the oscilloscope so that one cycle occupies precisely 5 horizontal divisions; (sweep rate is now 0.2 μsec/div).

4. Without readjusting the sweep rate, press the CANCEL button, then press the 5 Mc Sine Wave button.

5. Adjust trimmer C6 in the plate circuit of V1 so that 1 cycle per division is obtained; adjust display for maximum amplitude. *(Note:* The maximum Y amplitude on the scope should be held to 4 divisions.)

6. Adjust trimmer C7 also for 1 cycle per division; adjust display for maximum amplitude.

7. Repeat steps 4 through 6 several times until optimum deflection is obtained while retaining the 1-cycle-per-division condition.

The amplitude of the 5 Mc output signal should be 3 volts peak-to-peak or greater when terminated in a 50-ohm load; 6 volts peak-to-peak is the open circuit value.

5-8. ALIGNMENT OF THE 10 MC MULTIPLIER (Z110)

1. Use test setup of Figure 5-1.

2. Press the 5 Mc Sine Wave button. The frequency of the displayed signal has been determined in the previous test and is 5 megacycles.

3. Adjust the sweep rate of the oscilloscope so that one sine wave occupies precisely 2 horizontal divisions; (sweep rate is now 0.1 μsec/div).

4. Without readjusting the sweep rate, press the 10 Mc Sine Wave button.

5. Adjust trimmer C3 in the plate circuit of V1 so that 1 cycle per division is obtained; adjust display for maximum amplitude. (Keep maximum Y amplitude held to 4 divisions.)

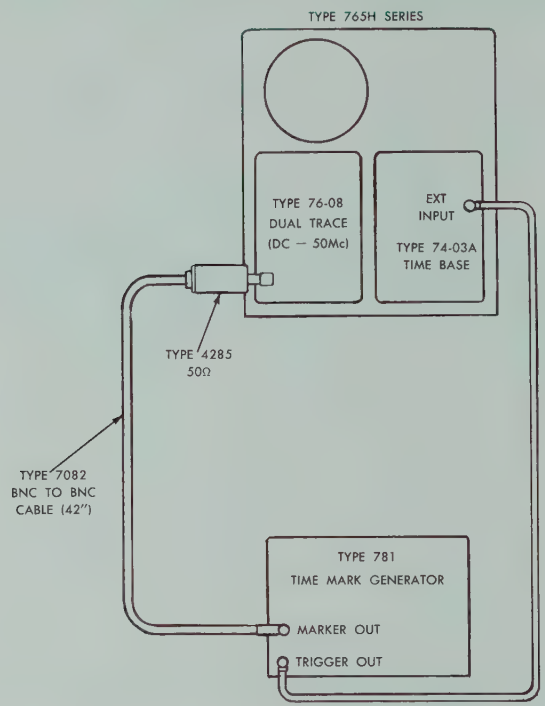


Figure 5-1.
Test Setup for Multiplier Alignment Procedure

6. Adjust trimmer C7 in the grid circuit of V2 also for 1 cycle per division; adjust display for maximum amplitude.

7. Repeat steps 4 through 6 several times until optimum deflection is obtained while retaining the 1-cycle-per-division condition.

The amplitude of the 10 Mc output signal should be 3 volts peak-to-peak or greater when terminated in a 50-ohm load; 6 volts peak-to-peak is the open circuit value.

5-9. ALIGNMENT OF THE 50 MC MULTIPLIER (Z110)

a. Alignment Procedure

1. Use test setup of Figure 5-1.

2. Press the 10 Mc Sine Wave button. The frequency of the displayed signal has been determined in the previous test and is 10 megacycles.

3. Adjust the sweep rate of the oscilloscope so that one sine wave occupies precisely 1 horizontal division; (sweep rate is now 100 nanosecs/div).

4. Without readjusting the sweep rate, press the 50 Mc Sine Wave button.

5. Adjust trimmer C10 in the plate circuit of V2 so that 5 cycles per division is obtained; adjust display for maximum amplitude.

Note: Do not use more than 3 divisions of Y amplitude on screen to avoid frequency response distortions.

6. Adjust trimmer C14 also for 5 cycles per division; adjust display for maximum amplitude. Use the center of the screen for optimum results.

7. Refer to modular card Z109 and adjust C11 so that 5 cycles per division is obtained; adjust display for maximum amplitude.

8. Repeat steps 4 through 7 several times until optimum deflection is obtained while retaining the 5 cycles per division condition.

b. Measuring Amplitude of 50 MC Output Signal

The amplitude of the 50 Mc output signal should be a minimum of 3 volts peak-to-peak when terminated in a 50-ohm load; 6 volts peak-to-peak is the open circuit value.

A dc to 50-megacycle bandwidth oscilloscope (or a much wider bandwidth of several hundred megacycles) must be used for checking the output amplitude of the 50 Mc signal.

The response of the oscilloscope amplifier will be down 3 to 4 db at 50 megacycles. This means that the display observed on the screen will measure only 60% to 70% of its actual amplitude. Also, the input capacity of the oscilloscope amplifier will shunt the 50-ohm termination with 23 pf. At 50 megacycles, the resulting 140-ohm reactive load makes the termination appear as a 43-ohm load on the generator. This factor takes another 15% from the peak-to-peak 50 Mc

sine wave output. When these parameters are taken into consideration, only about 45% of the peak-to-peak signal is observed on the screen. If the 50 Mc Y Amplifier shown in Figure 5-1 is set for 1 volt/division, then any peak-to-peak amplitude in excess of 1.35 divisions indicates that the Type 781 Generator is performing satisfactorily at 50 Mc.

If the Type 7093 (5:1, 50-ohm) pad is used to terminate the Generator at the input to the oscilloscope, then the scope will see a 10-ohm source while the Type 781 will not be loaded by the input shunt capacity of the scope.

If the Type 76-08 (50 Mc Plug-in) VOLTS/DIV switch is set to 200 millivolts, then any peak-to-peak amplitude in excess of 3.5 divisions indicates that the Type 781 Generator is performing satisfactorily. This latter test employing the Type 7093 pad is the preferred procedure.

5-10. DIVIDER CIRCUIT ALIGNMENT (Z101 & Z107)

Note: All adjustments are made with a X10 passive Attenuator Probe connected to Channel 1 and another one connected to Channel 2 of the Dual Trace Test Oscilloscope. Use the alligator clip as a probe tip when clamping transistor. If the case of the transistor is painted, make certain that the alligator clip jaws bite through the paint to make a good contact. Two basic divider circuits are used for time division and are to be calibrated in the sequence indicated in Table 5-1.

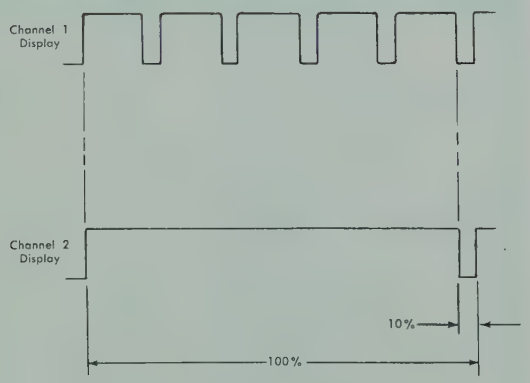
a. 5:1 Divider (Figure 5-2)

1. Set up the Test Oscilloscope for dual trace chopped mode and external triggering from the Type 781 Trigger Output switched to the nearest marker frequency.
2. Connect the probe from Channel 1 of the Dual-Trace Oscilloscope to the collector (case) of Q2 located on modular card Z108.
3. Connect the probe from Channel 2 of the Dual-Trace Oscilloscope to the collector (case) of Q1 located on modular card Z101.
4. Adjust the 5 μsec potentiometer R2 located on modular card Z101, to produce a 5:1 division in time of the displayed waveform on Channel 2 as indicated in Figure 5-2.
5. The 5:1 Divider potentiometer R2 also has an effect on the output pulse width. Adjust R2 so that the output pulse width is 10% of interval between output pulses.

b. 2:1 Divider Circuit (Figure 5-3)

Note: The test setup for adjustments of the 2:1 Divider Circuit is identical to the setup for the 5:1 Divider.

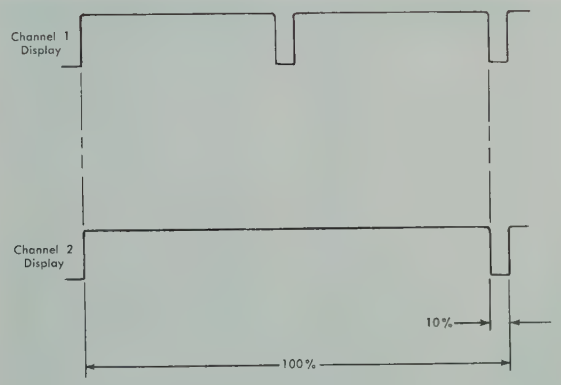
1. Connect the probe from Channel 1 of the Dual-Trace Oscilloscope to the collector (case) of Q1 located on modular card Z101.
2. Connect the probe from Channel 2 of the Dual-



Channel 1 display represents the input to the 5:1 Divider at the collector of Q2 on card Z108; Q5 collector for all other 5:1 dividers.

Channel 2 display represents the output from the 5:1 Divider at the collector of Q1 of the next card in the timing chain.

Figure 5-2. Waveform Display for 5:1 Divider



Channel 1 display represents the input to the 2:1 Divider at the collector of Q1.

Channel 2 display represents the output from the 2:1 Divider at the collector of Q5 on the same card as Q1.

Figure 5-3. Waveform Display for 2:1 Divider

Trace Oscilloscope to the collector (case) of Q5 located on the same modular card Z101.

3. Adjust the 10 μsec potentiometer R13 located on modular card Z101 to produce a 2:1 division in time of the displayed waveform on Channel 2 as indicated in Figure 5-3.

4. The 2:1 Divider potentiometer R13 has an effect on the output pulse width. Adjust R13 so that the output pulse width is 10% of the interval between output pulses.

NOTE: The preceding steps were given in detail for the 5 μsec and 10 μsec marker circuits. Since all of the divider circuits are similarly adjusted, a tabular outline is deemed sufficient for the remaining dividers. All alignments must be made in the sequence indicated in Table 5-1.

TABLE 5-1. DIVIDER CIRCUIT ALIGNMENT CHART

SEQUENCE	Set Sweep TIME/DIV switch to	Oscilloscope Connection CHANNEL 1 On Card	CHANNEL 1 Connect probe to case of	CHANNEL 2 On Card	CHANNEL 2 Connect probe to case of	Adjust pot below (see Fig. 5-4)	For Ch. 2 display, refer to Fig. below
1	0.5 μsec	Z108	Q2	Z101	Q1	5 μsec	5-2
2	1 μsec	Z101	Q1	Z101	Q5	10 μsec	5-3
3	5 μsec	Z101	Q5	Z102	Q1	50 μsec	5-2
4	10 μsec	Z102	Q1	Z102	Q5	100 μsec	5-3
5	50 μsec	Z102	Q5	Z103	Q1	0.5 msec	5-2
6	100 μsec	Z103	Q1	Z103	Q5	1 msec	5-3
7	500 μsec	Z103	Q5	Z104	Q1	5 msec	5-2
8	1 msec	Z104	Q1	Z104	Q5	10 msec	5-3
9	5 msec	Z104	Q5	Z105	Q1	50 msec	5-2
10	10 msec	Z105	Q1	Z105	Q5	100 msec	5-3
11	50 msec	Z105	Q5	Z106	Q1	500 msec	5-2
12	100 msec	Z106	Q1	Z106	Q5	1 sec	5-3
13	500 msec	Z106	Q5	Z107	Q1	5 sec	5-2

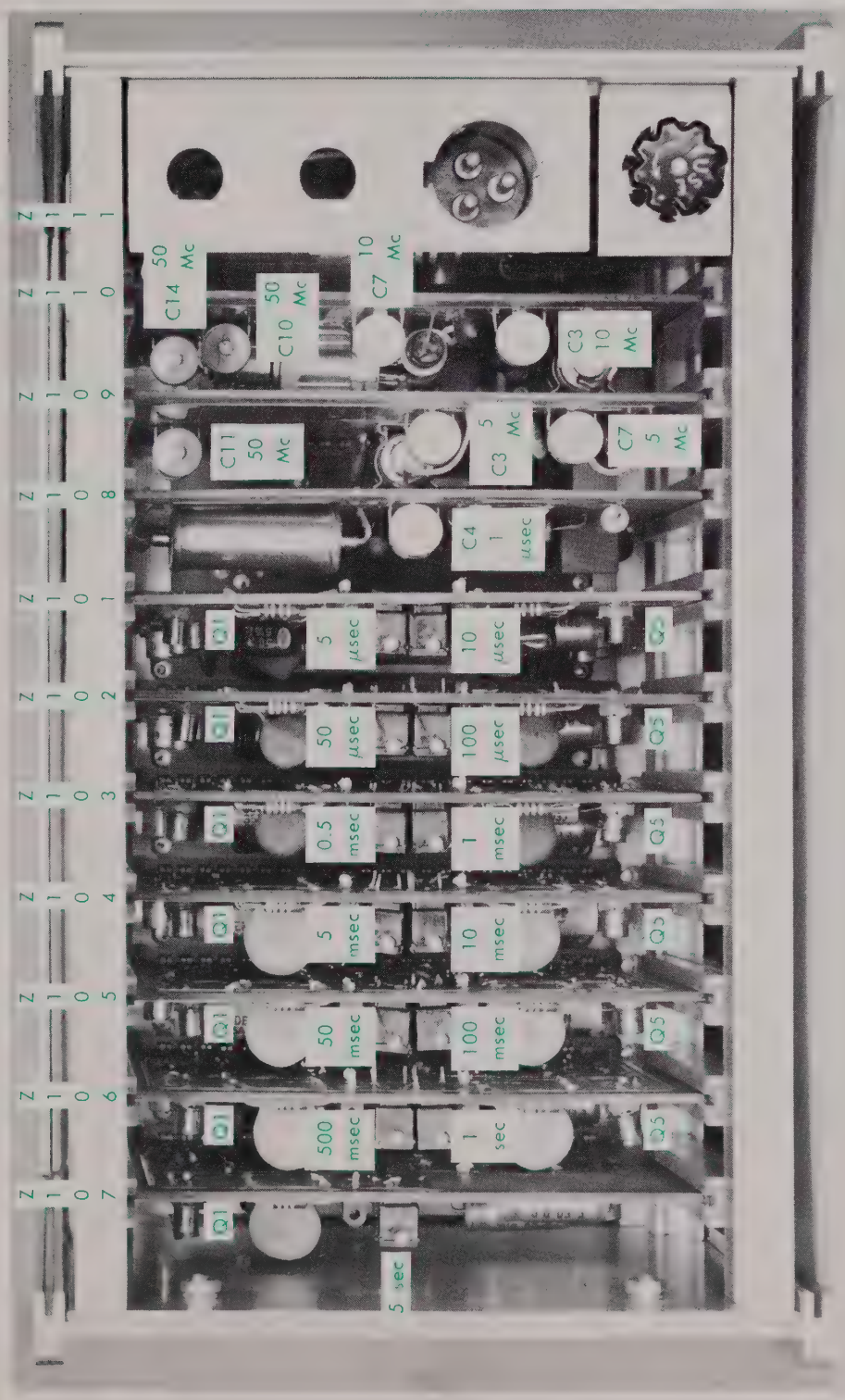


Figure 5-4. Identification of Modular Cards and Alignment Controls

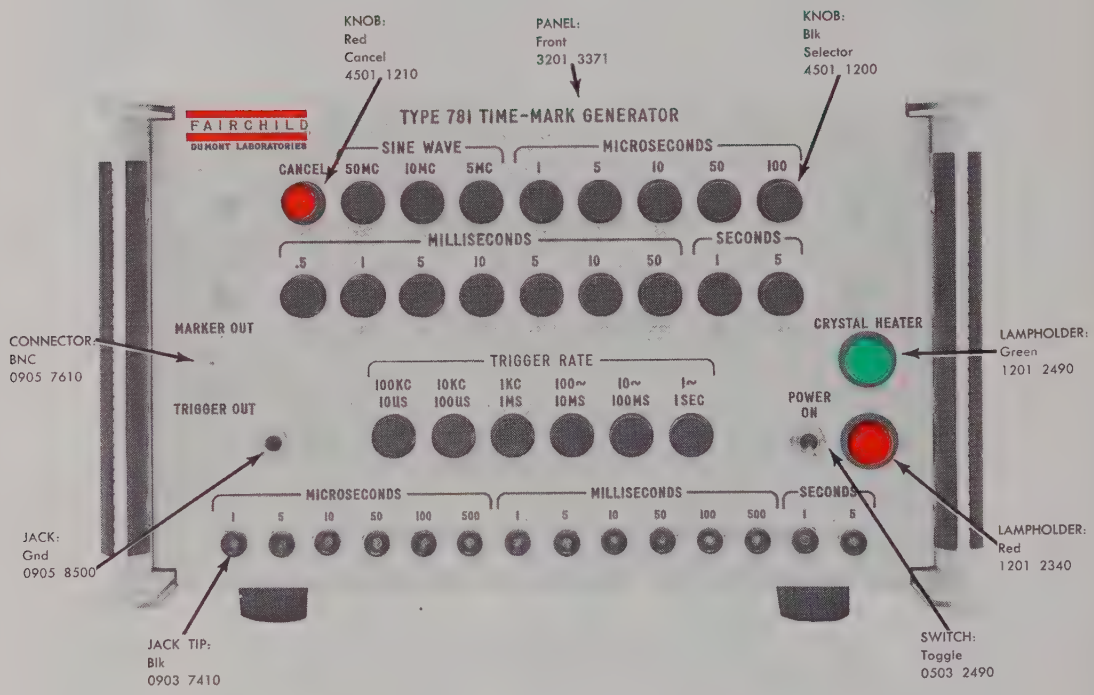


Figure 6-1. Front-Panel Replaceable Parts

SECTION 6
PARTS LISTS AND SCHEMATICS

INTRODUCTION

The timing circuits of the Type 781A Time-Mark Generator are assembled on 11 printed wiring modules. Each printed wiring module is designed as a plug-in card that permits it to be easily removed for routine maintenance or for simple replacement. In addition, each printed wiring plug-in card is uniquely keyed for its particular mating connector. This technique eliminates the possibility of inserting the plug-in modular card into the wrong connector.

Section 6A comprises the regular electrical parts list and Section 6B the Spare Parts List.

The Electrical Parts List is set up by modules. Each module is identified by a Line Drawing showing all components assembled in their proper location and also a tabulation of those components.

The Electrical Parts List is arranged in the outline below. The prefix 3103 – used in the outline and also shown at the top left side of each card, identifies the *blank* card only, that is, without components. The Card Assembly Number includes all of the electrical components shown on their respective modular cards.

Modular Card	Description	*Blank Card Part No.	Card Ass'y No.
Z101	5 μsec & 10 μsec	3103 3302	8700 1641
Z102	50 μsec & 100 μsec	3103 3342	8700 1651
Z103	0.5 msec & 1 msec	3103 3372	8700 1661
Z104	5 msec & 10 msec	3103 3402	8700 1671
Z105	50 msec & 100 msec	3103 3432	8700 1681
Z106	500 msec & 1 sec	3103 3462	8700 1691
Z107	5 sec & Trig Buffer	3103 3492	8700 1701
Z108	1 Mc	3103 3522	8700 1711
Z109	5 Mc	3103 3552	8700 1721
Z110	10 Mc & 50 Mc	3103 3582	8700 1731
Z111	Power Supply	3103 3612	8700 1741

* For Type 781 only, the last digit of the part number is 1.

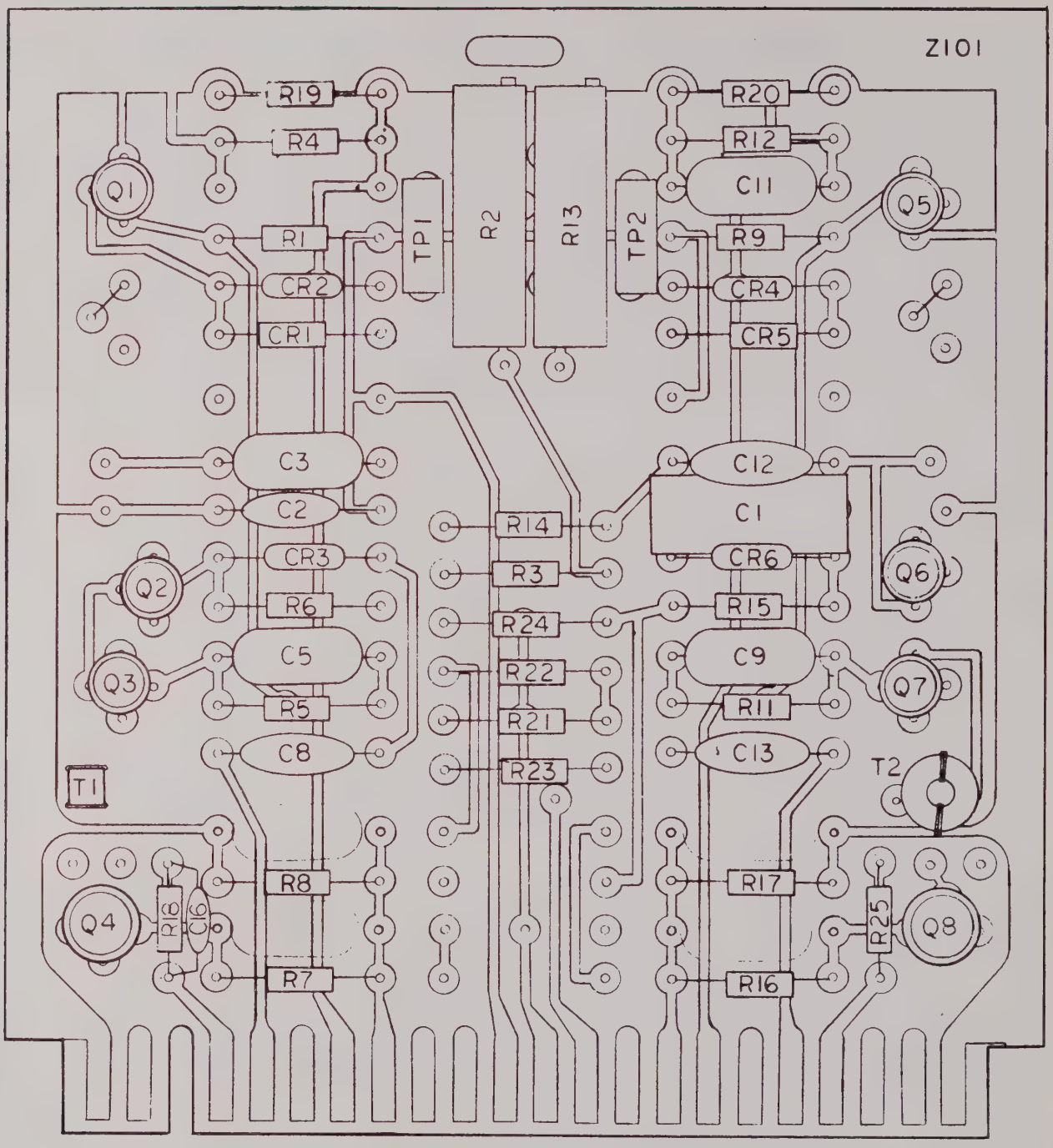


Figure 6-2. Replaceable Components on Modular Card Z101

CAPACITORS

Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.

GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0317 5200	50 pf	EMC	DM15
C5	0317 0090	ceramic, 100 pf, ±10%	EIA	
C8	0315 3550	ceramic, 33 pf, ±10%	EIA	
C9	0317 0090	ceramic, 100 pf, ±10%	EIA	
C11	0317 5200	50 pf	EMC	DM15
C12	0317 5280	ceramic, 100 pf	EMC	DM15
C13	0315 3550	ceramic, 33 pf, ±10%	EIA	
C16	0326 4520	ceramic, 1000 pf, GMV	ERC	831

SEMICONDUCTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
CR1	2600 6930	diode, FD100	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6930	diode, FD100	FCI	
CR6	2600 6910	diode, FD841	FCI	

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7020	DU #1A	FCI	
Q2 & Q3	2600 7000	alternate, 2N914		
	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 5970	1K	ALB	CB
R2	0109 2130	variable, 50K, ±20%, .2W (5:1 ADJ)	BNS	3068P1503
R3	0235 5100	110K, ±5%	ALB	CB
R4	0235 4680	2K, ±5%	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2130	variable, 50K, ±20%, .2W (2:1 ADJ)	BNS	3068P1503
R14	0235 5100	110K, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 5920	390	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 to R24	0235 4550	510, ±5%	ALB	CB
R25	0235 5920	390	ALB	CB

TRANSFORMERS

Symbol	Part Number	Description	Recommended Vendor Code	Type
T1	2001 4681	pulse	ABD	
T2	2001 3852	pulse	ABD	

TEST POINTS

Symbol	Part Number	Description	Recommended Vendor Code	Type
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

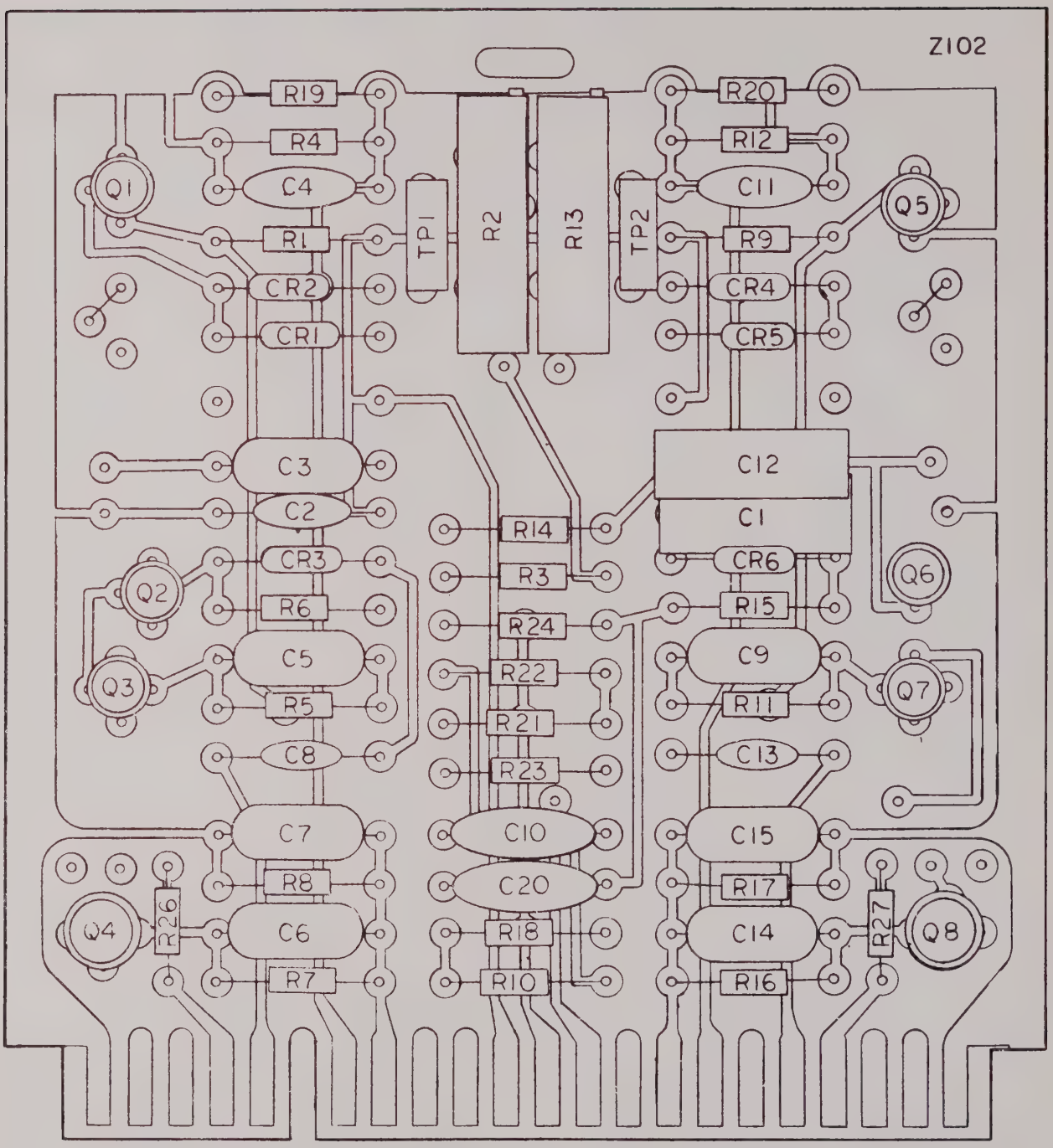


Figure 6-3. Replaceable Components on Modular Card Z102

Symbol	Part Number	Description	Recommended Vendor Code	Type
CAPACITORS				
Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.				
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0317 5460	mica, 500 pf, 300V	EMC	DM15
C4	0317 0090	ceramic, 100 pf, ±10%	EIA	
C5 & C6	0317 5200	50 pf	EMC	DM15
C7	0317 5350	200 pf	EMC	DM15
C8	0317 0020	ceramic, 33 pf, ±10%	EIA	
C9	0317 5200	50 pf	EMC	DM15
C10	0316 9530	ceramic, 2000 pf, ±10%, 1000V	RMC	JL
C11	0317 0090	ceramic, 100 pf, ±10%	EIA	
C12	0326 8790	plastic, 1000 pf, 100V	GUD	355B
C13	0317 0020	ceramic, 33 pf, ±10%	EIA	
C14	0317 5200	50 pf	EMC	DM15
C15	0317 5350	200 pf	EMC	DM15
C20	0316 9530	ceramic, 2000 pf, ±10%, 1000V	RMC	JL
SEMICONDUCTORS				
CR1	2600 6820	diode, FD281	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6820	diode, FD281	FCI	
CR6	2600 6910	diode, FD841	FCI	
TRANSISTORS				
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q2 & Q3	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
RESISTORS				
Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.				
R1	0235 5970	1K	ALB	CB
R2	0109 2130	variable, 50K, ±20%, .2W (5:1 ADJ)	BNS	3068P1503
R3	0235 5100	110K, ±5%	ALB	CB
R4	0235 4680	2K, ±5%	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2130	variable, 50K, ±20%, .2W (2:1 ADJ)	BNS	3068P1503
R14	0235 5100	110K, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 4550	510, ±5%	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 to R24	0235 4550	510, ±5%	ALB	CB
R26 & R27	0235 5950	680	ALB	CB
TEST POINTS				
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

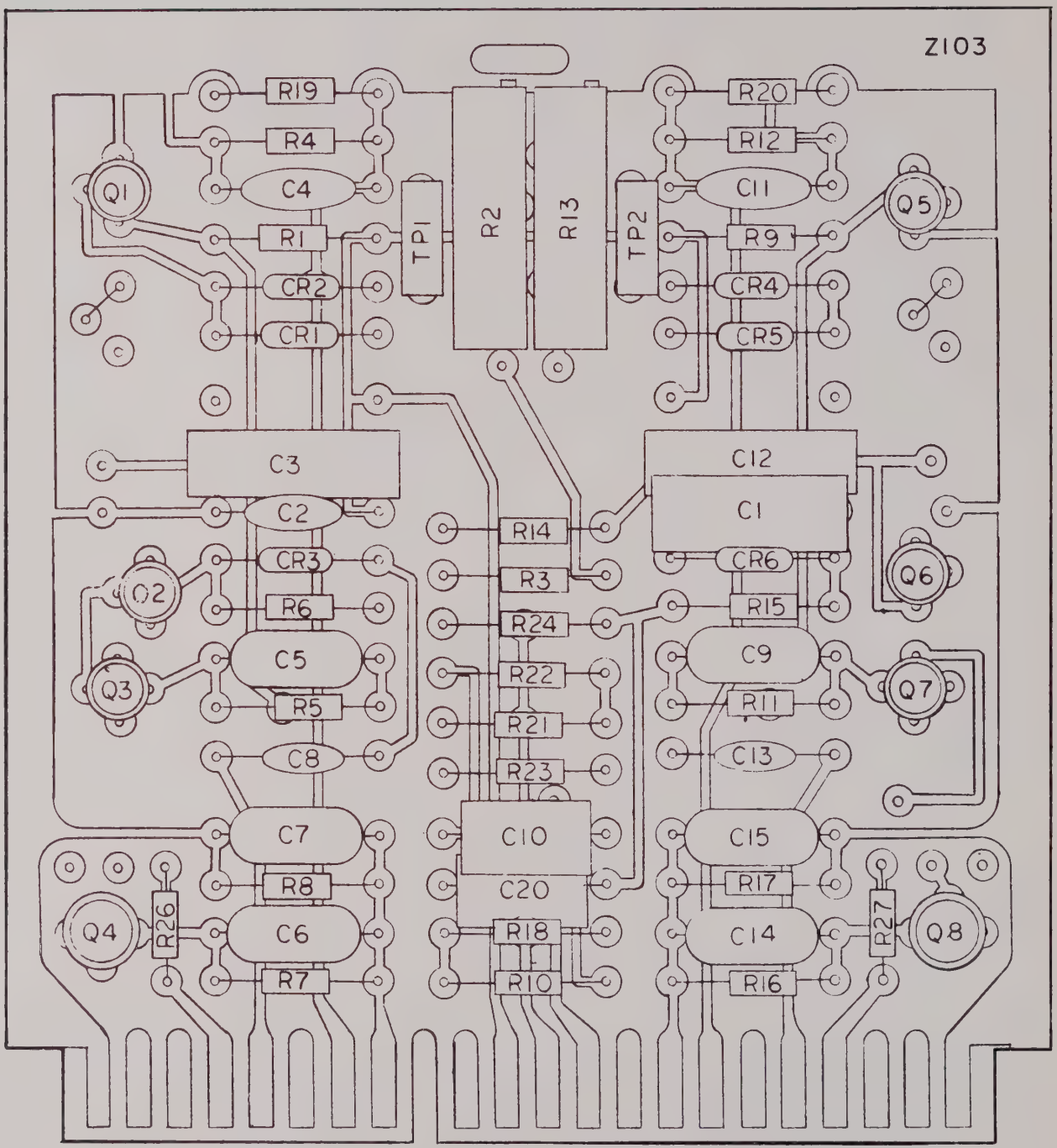


Figure 6-4. Replaceable Components on Modular Card Z103

CAPACITORS

Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0326 8800	plastic, 0.0047 μf, 100V	GUD	355B
C4	0317 0090	ceramic, 100 pf, ±10%	EIA	
C5 & C6	0317 5200	50 pf	EMC	DM15
C7	0317 5350	200 pf	EMC	DM15
C8	0317 3820	ceramic, 220 pf, ±10%	EIA	
C9	0317 5200	50 pf	EMC	DM15
C10	0326 7820	plastic, 0.022 μf, ±10%, 125V	AMX	C296AA
C11	0317 0090	ceramic, 100 pf, ±10%	EIA	
C12	0326 8810	plastic, 0.01 μf, 100V	GUD	355B
C13	0317 3820	ceramic, 220 pf, ±10%	EIA	
C14	0317 5200	50 pf	EMC	DM15
C15	0317 5350	200 pf	EMC	DM15
C20	0326 7820	plastic, 0.022 μf, ±10%, 125V	AMX	C296AA

SEMICONDUCTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
CR1	2600 6820	diode, FD281	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6820	diode, FD281	FCI	
CR6	2600 6910	diode, FD841	FCI	

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q2 & Q3	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 5970	1K	ALB	CB
R2	0109 2130	variable, 50K, ±20%, .2W (5:1 ADJ)	BNS	3068P1503
R3	0235 5100	110K, ±5%	ALB	CB
R4	0235 4680	2K, ±5%	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2130	variable, 50K, ±20%, .2W (2:1 ADJ)	BNS	3068P1503
R14	0235 5100	110K, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 4550	510, ±5%	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 to R24	0235 4550	510, ±5%	ALB	CB
R26 & R27	0235 5950	680	ALB	CB

TEST POINTS

Symbol	Part Number	Description	Recommended Vendor Code	Type
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

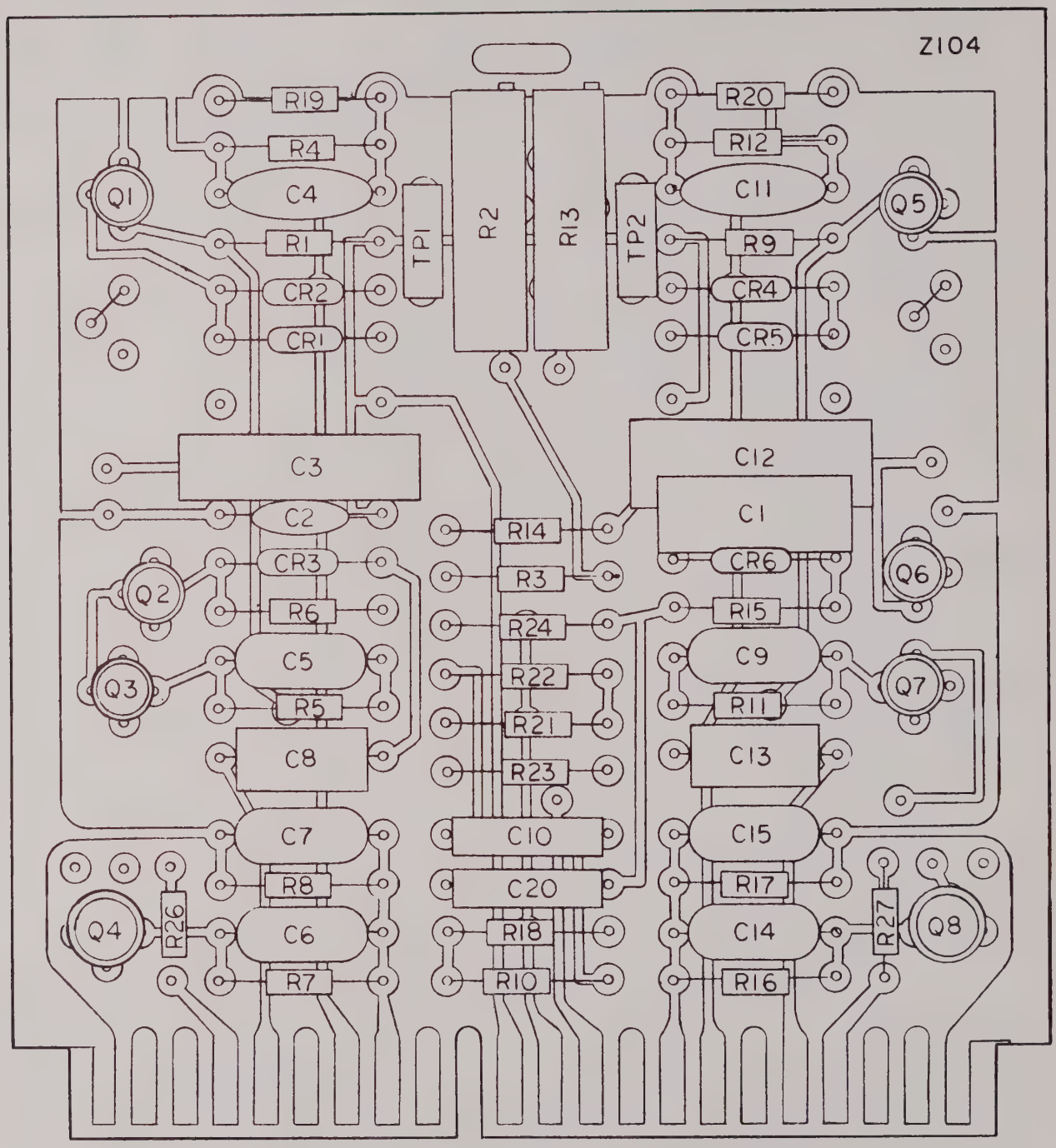


Figure 6-5. Replaceable Components on Modular Card Z104

CAPACITORS

Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0326 8830	plastic, 0.047 μf, 100V	GUD	355B
C4	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C5 & C6	0317 5200	50 pf	EMC	DM15
C7	0317 5350	200 pf	EMC	DM15
C8	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C9	0317 5200	50 pf	EMC	DM15
C10	0327 3150	ceramic, 0.2 μf, +80 −20%, 10V	CRL	DA-472
C11	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C12	0326 8820	plastic, 0.1 μf, 100V	GUD	355B
C13	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C14	0317 5200	50 pf	EMC	DM15
C15	0317 5350	200 pf	EMC	DM15
C20	0327 3150	ceramic, 0.2 μf, +80 −20%, 10V	CRL	DA-472

SEMICONDUCTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
CR1	2600 6820	diode, FD281	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6820	diode, FD281	FCI	
CR6	2600 6910	diode, FD841	FCI	

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q2 & Q3	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 5970	1K	ALB	CB
R2	0109 2130	variable, 50K, ±20%, .2W (5:1 ADJ)	BNS	3068P1503
R3	0235 5100	110K, ±5%	ALB	CB
R4	0235 4680	2K, ±5%	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2130	variable, 50K, ±20%, .2W (2:1 ADJ)	BNS	3068P1503
R14	0235 5100	110K, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 4550	510, ±5%	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 to R24 R26 & R27	0235 4550	510, ±5%	ALB	CB
	0235 5950	680	ALB	CB

TEST POINTS

Symbol	Part Number	Description	Recommended Vendor Code	Type
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

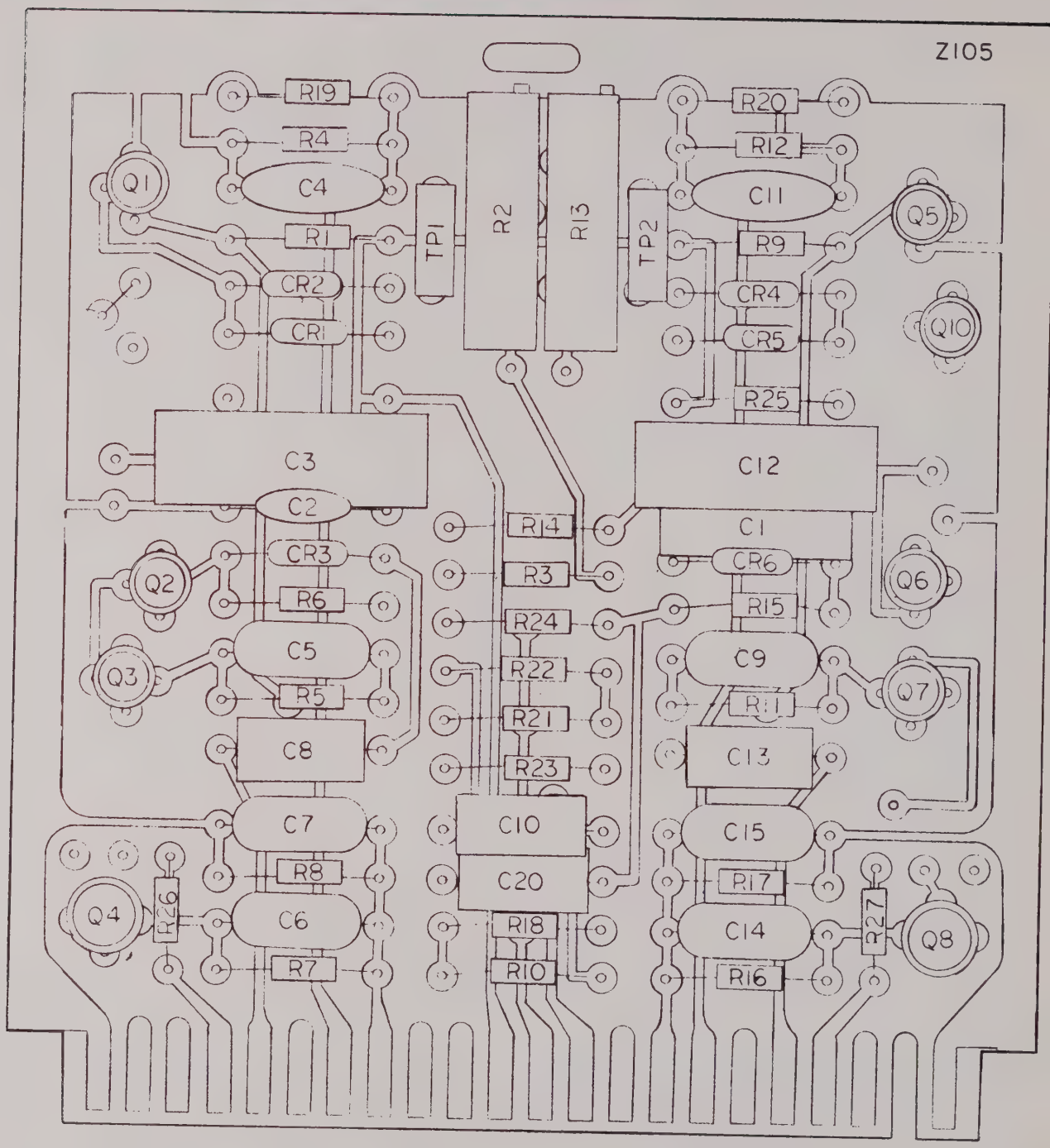


Figure 6-6. Replaceable Components on Modular Card Z105

CAPACITORS

Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0326 8830	plastic, 0.047 μf, 100V	GUD	355B
C4	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C5 & C6	0317 5200	50 pf	EMC	DM15
C7	0317 5350	200 pf	EMC	DM15
C8	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C9	0317 5200	50 pf	EMC	DM15
C10	0327 3150	ceramic, 0.2 μf, +80 −20%, 10V	CRL	DA-472
C11	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C12	0326 8820	plastic, 0.1 μf, 100V	GUD	355B
C13	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C14	0317 5200	50 pf	EMC	DM15
C15	0317 5350	200 pf	EMC	DM15
C20	0327 3150	ceramic, 0.2 μf, +80 −20%, 10V	CRL	DA-472

SEMICONDUCTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
CR1	2600 6820	diode, FD281	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6820	diode, FD281	FCI	
CR6	2600 6910	diode, FD841	FCI	

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q2 & Q3	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 5970	1K	ALB	CB
R2	0109 2130	variable, 50K, ±20%, .2W (5:1 ADJ)	BNS	3068P1503
R3	0235 5100	110K, ±5%	ALB	CB
R4	0235 4680	2K, ±5%	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2130	variable, 50K, ±20%, .2W (2:1 ADJ)	BNS	3068P1503
R14	0235 5100	110K, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 4550	510, ±5%	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 to R24 R26	0235 4550	510, ±5%	ALB	CB
& R27	0235 5950	680	ALB	CB

TEST POINTS

Symbol	Part Number	Description	Recommended Vendor Code	Type
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

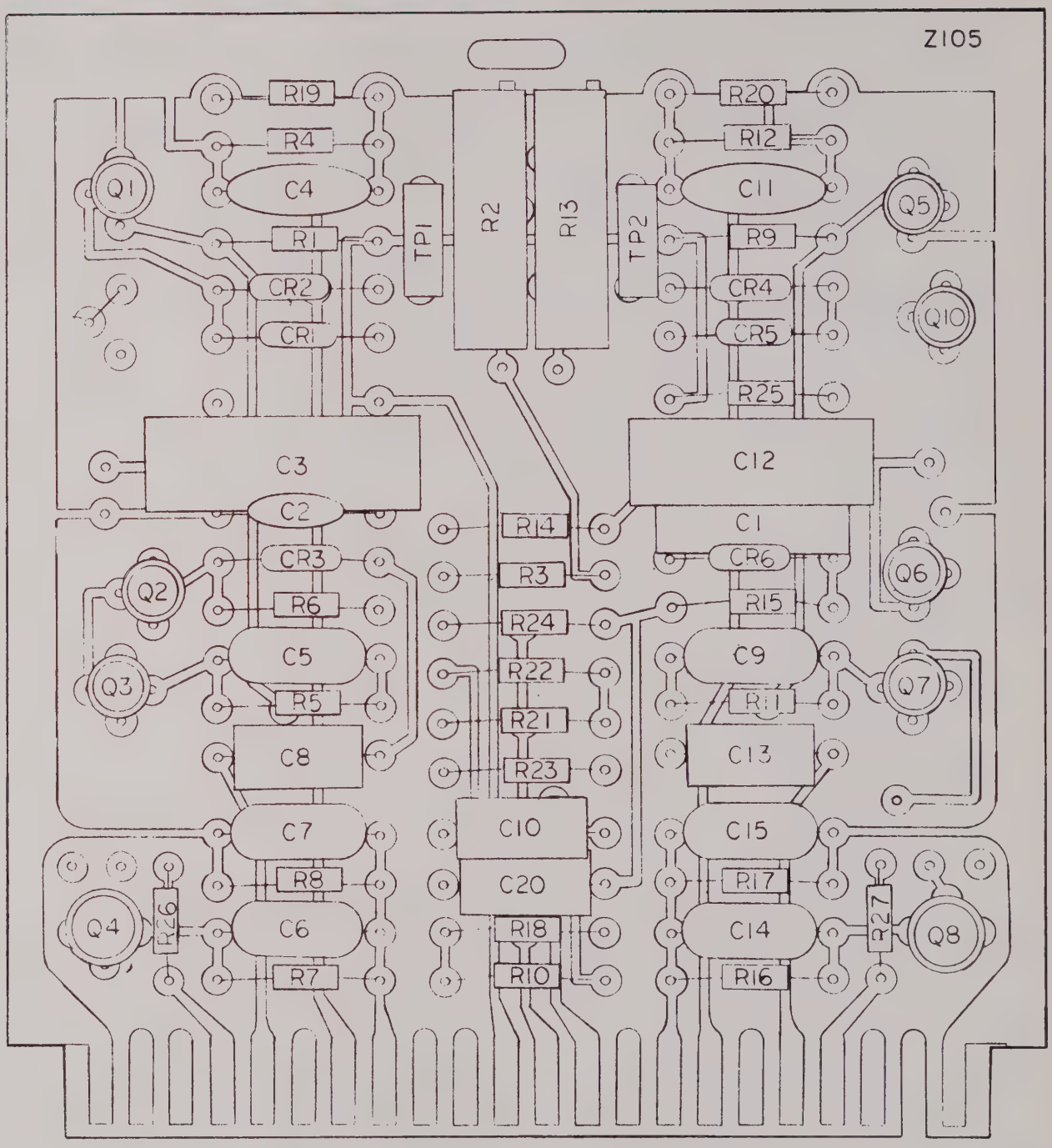


Figure 6-6. Replaceable Components on Modular Card Z105

CAPACITORS

Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0327 3020	plastic, 0.47 μf, 50V	GUD	355B
C4	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C5 & C6	0317 5200	50 pf	EMC	DM15
C7	0317 5350	200 pf	EMC	DM15
C8	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2331
C9	0317 5200	50 pf	EMC	DM15
C10	0326 7640	electrolytic, 2 μf, +100 −10%, 50V	SPG	30D190A1
C11	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C12	0326 8820	plastic, 0.1 μf, 100V	GUD	355B
C13	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C14	0317 5200	50 pf	EMC	DM15
C15	0317 5350	200 pf	EMC	DM15
C20	0326 7640	electrolytic, 2 μf, +100 −10%, 50V	SPG	30D190A1

SEMICONDUCTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
CR1	2600 6820	diode, FD281	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6820	diode, FD281	FCI	
CR6	2600 6910	diode, FD841	FCI	

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q2 &Q3	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q10	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 5970	1K	ALB	CB
R2	0109 2130	variable, 50K, ±20%, .2W (5:1 ADJ)	BNS	3068P1503
R3	0235 5100	110K, ±5%	ALB	CB
R4	0235 4680	2K, ±5%	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2140	variable, 500K, ±20%, .2W (2:1 ADJ)	BNS	3068P1503
R14	0235 5340	1.1M, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 4550	510, ±5%	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 to R24 R26	0235 4550	510, ±5%	ALB	CB
& R27	0235 5950	680	ALB	CB

TEST POINTS

Symbol	Part Number	Description	Recommended Vendor Code	Type
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

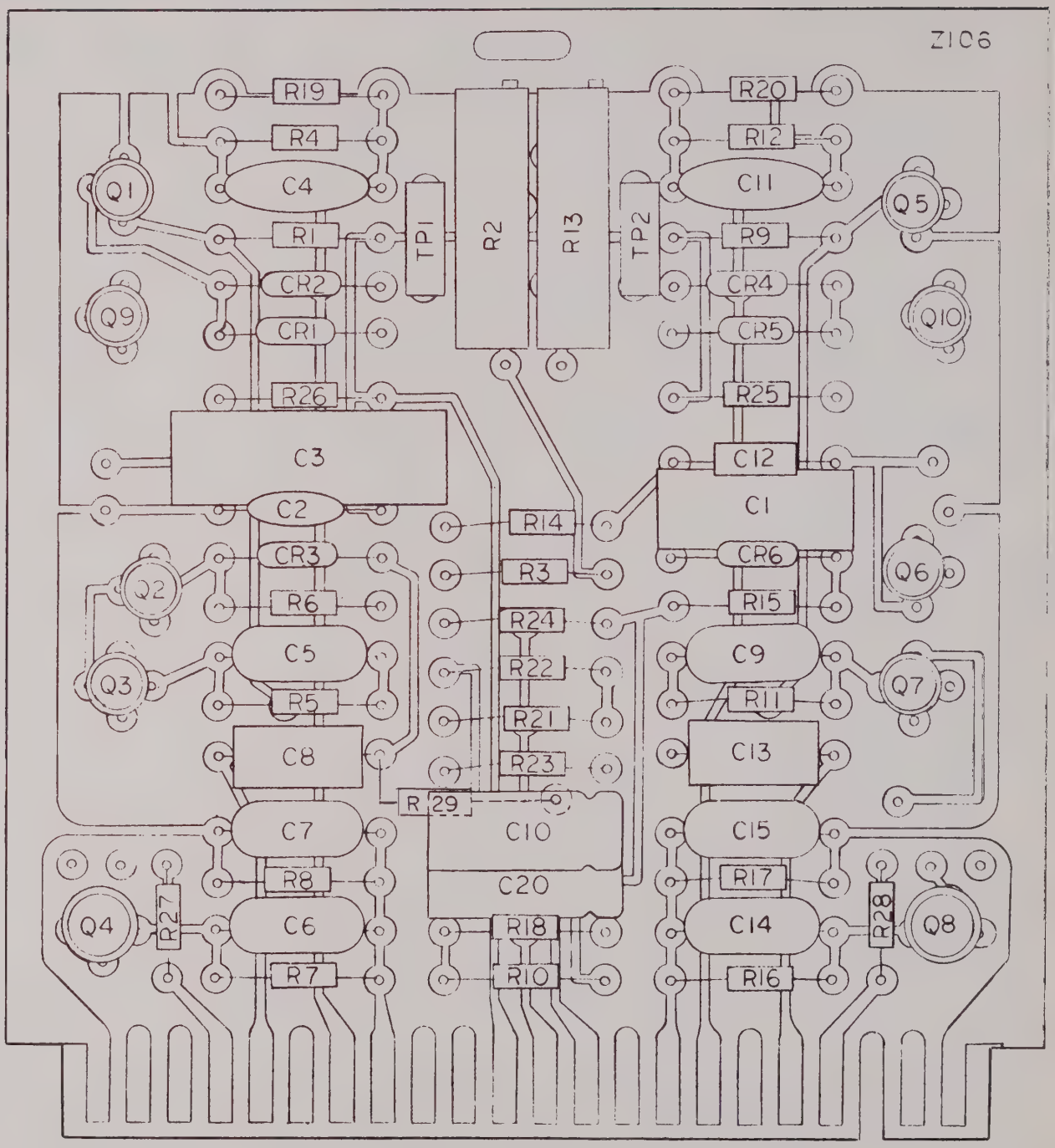


Figure 6-7. Replaceable Components on Modular Card Z106

CAPACITORS

Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0327 3020	plastic, 0.47 μf, 50V	GUD	355B
C4	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C5 & C6	0317 5200	50 pf	EMC	DM15
C7	0317 5350	200 pf	EMC	DM15
C8	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2331
C9	0317 5200	50 pf	EMC	DM15
C10	0326 7640	electrolytic, 2 μf, +100 −10%, 50V	SPG	30D190A1
C11	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C12	0326 8820	plastic, 0.1 μf, 100V	GUD	355B
C13	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C14	0317 5200	50 pf	EMC	DM15
C15	0317 5350	200 pf	EMC	DM15
C20	0326 7640	electrolytic, 2 μf, +100 −10%, 50V	SPG	30D190A1

SEMICONDUCTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
CR1	2600 6820	diode, FD281	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6820	diode, FD281	FCI	
CR6	2600 6910	diode, FD841	FCI	

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q2 &Q3	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q10	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 5970	1K	ALB	CB
R2	0109 2130	variable, 50K, ±20%, .2W (5:1 ADJ)	BNS	3068P1503
R3	0235 5100	110K, ±5%	ALB	CB
R4	0235 4680	2K, ±5%	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2140	variable, 500K, ±20%, .2W (2:1 ADJ)	BNS	3068P1503
R14	0235 5340	1.1M, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 4550	510, ±5%	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 to R24	0235 4550	510, ±5%	ALB	CB
R26 & R27	0235 5950	680	ALB	CB

TEST POINTS

Symbol	Part Number	Description	Recommended Vendor Code	Type
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

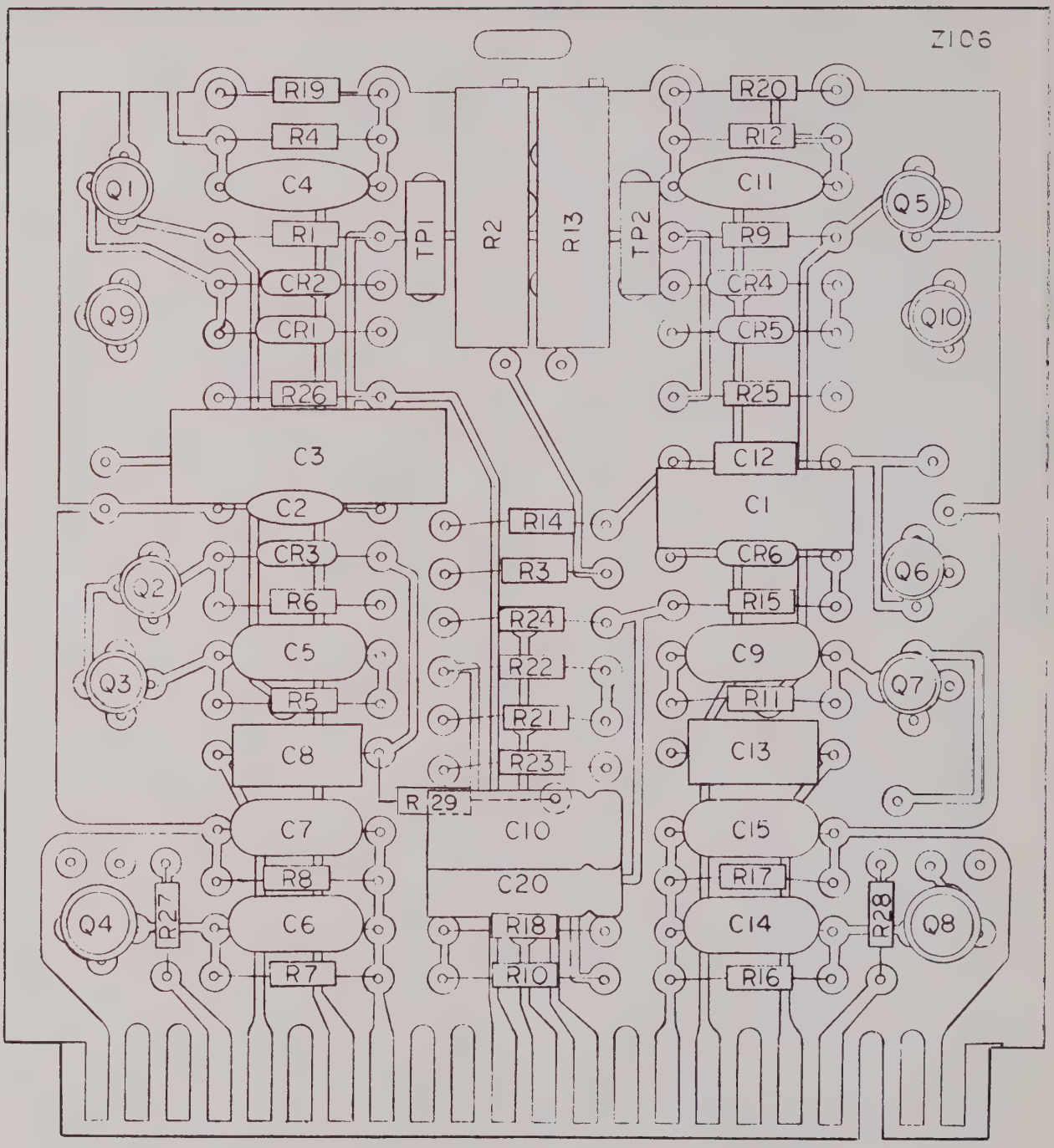


Figure 6-7. Replaceable Components on Modular Card Z106

CAPACITORS

Note: All capacitors are fixed, mica, ±5%, and 500V unless otherwise specified; pf denotes picofarads.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
C2	0319 1060	ceramic, 0.01 μf, +60 −40%, 150V	CRL	DDM
C3	0327 3020	plastic, 0.47 μf, 50V	GUD	355A
C4	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C5 & C6	0317 5200	50 pf	EMC	DM15
C7	0317 5350	200 pf	EMC	DM15
C8	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C9	0317 5200	50 pf	EMC	DM15
C10	0327 3220	electrolytic, 15 μf, +75 −10%, 12V	SPG	30D148A1
C11	0316 9480	ceramic, 1000 pf, ±10%, 1000V	RMC	JL
C12	0327 3170	electrolytic, 1 μf, 50V	SPG	150D
C13	0316 6550	ceramic, 200 pf, ±10%	ERC	GP2-331
C14	0317 5200	50 pf	EMC	DM15
C15	0317 5350	200 pf	EMC	DM15
C20	0327 3220	electrolytic, 15 μf, +75 −10%, 12V	SPG	30D148A1

SEMICONDUCTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
CR1	2600 6820	diode, FD281	FCI	
CR2 to CR4	2600 6910	diode, FD841	FCI	
CR5	2600 6820	diode, FD281	FCI	
CR6	2600 6910	diode, FD841	FCI	

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q2 & Q3	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q4	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q5	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q6 & Q7	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q8	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q9 & Q10	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 5970	1K	ALB	CB
R2	0109 2140	variable, 500K, ±20%, .2W (5:1 ADJ)	BNS	3068P1504
R3	0235 5340	1.1M, ±5%	ALB	CB
R4	0235 4680	2K	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 6030	3.3K	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 5890	220	ALB	CB
R9	0235 5970	1K	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 6140	27K	ALB	CB
R12	0235 4680	2K, ±5%	ALB	CB
R13	0109 2140	variable, 500K, ±20%, .2W (2:1 ADJ)	BNS	3068P1504
R14	0235 5340	1.1M, ±5%	ALB	CB
R15	0235 6030	3.3K	ALB	CB
R16	0235 5970	1K	ALB	CB
R17	0235 5890	220	ALB	CB
R18	0235 4550	510, ±5%	ALB	CB
R19 & R20	0235 6150	33K	ALB	CB
R21 & R22	0235 4550	510, ±5%	ALB	CB
R23 & R24	0235 4550	510, ±5%	ALB	CB
R25 & R26	0235 5970	1K	ALB	CB
R27 & R28	0235 5950	680	ALB	CB

TEST POINTS

Symbol	Part Number	Description	Recommended Vendor Code	Type
TP1 & TP2	4101 2140	green	UCN	119437

NOTES

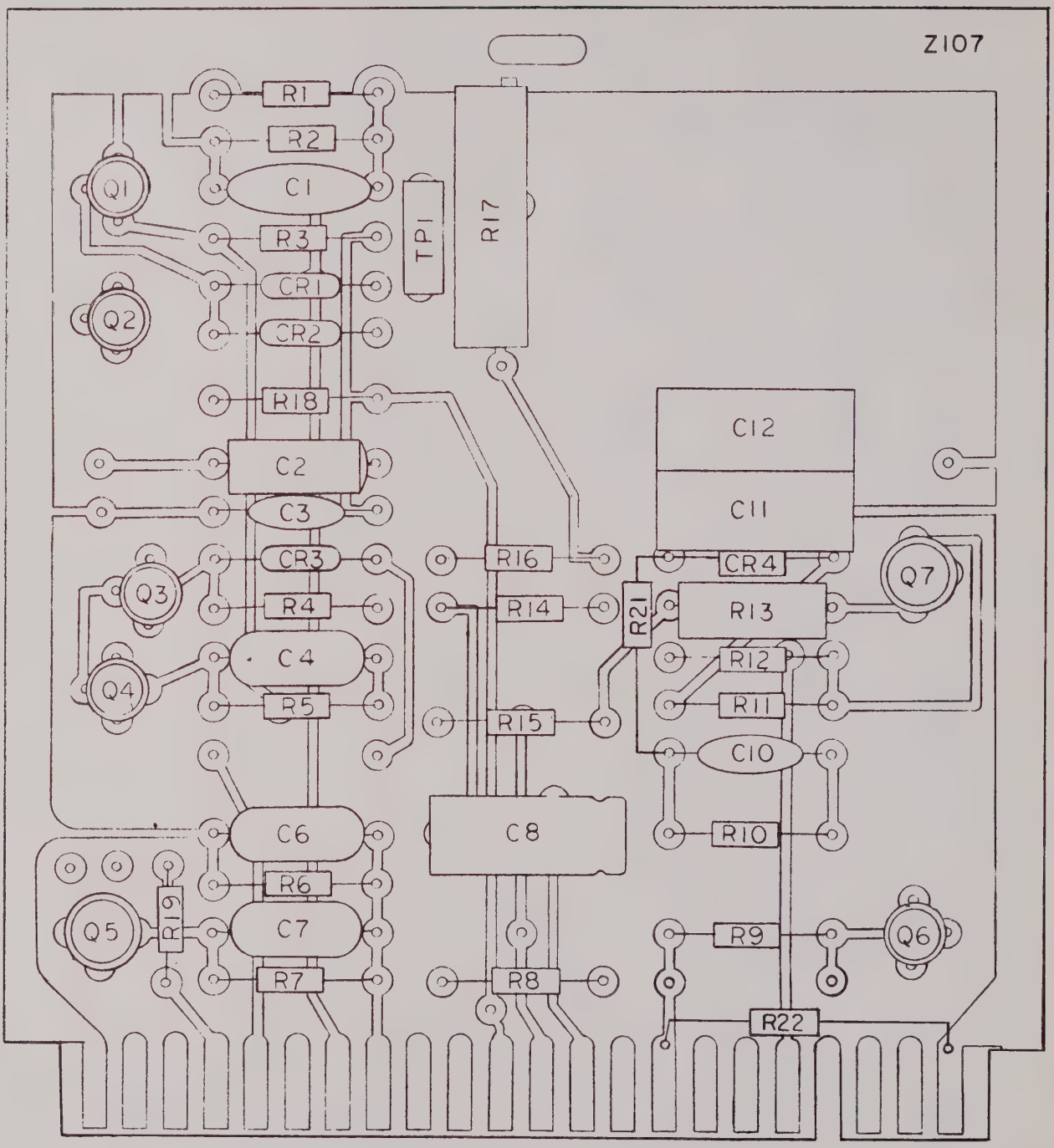


Figure 6-8. Replaceable Components on Modular Card Z107

Symbol	Part Number	Description	Recommended Vendor Code	Type
CAPACITORS				
Note: All capacitors are fixed, ceramic, ±5%, and 500V unless otherwise specified; pf denotes picofarads.				
C1	0316 9480	1000 pf, ±10%, 1000V	RMC	JL
C2	0327 3180	electrolytic, 4.7 μf, 50V	SPG	150D
C3	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C4	0317 5200	mica, 50 pf	EMC	DM15
C6	0317 5350	mica, 200 pf	EMC	DM15
C7	0317 5200	mica, 50 pf	EMC	DM15
C8	0327 3220	electrolytic, 15 μf, +75 −10%, 12V	SPG	30D148A1
C10	0305 5240	mica, 200 pf	EIA	
C11 & C12	0326 7620	electrolytic, 5 μf, +100 −10%, 50V	SPG	30D193A1
SEMICONDUCTORS				
CR1	2600 6910	diode, FD841	FCI	
CR2	2600 6820	diode, FD281	FCI	
CR3	2600 6910	diode, FD841	FCI	
CR4	2600 8130	diode, 1N716	EIA	
TRANSISTORS				
Q1	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q2 to Q4	2600 7060	DU #2	FCI	
	2600 7050	alternate, 2N915		
Q5	2600 7170	DU #4A	FCI	
	2600 7150	alternate, 2N1132		
Q6	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q7	2600 7420	DU #9A	FCI	
	2600 7400	alternate, 2N869		
RESISTORS				
Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.				
R1	0235 6270	330K	ALB	CB
R2	0235 6090	10K	ALB	CB
R3	0235 5970	1K	ALB	CB
R4	0235 6030	3.3K	ALB	CB
R5	0235 6140	27K	ALB	CB
R6	0235 5890	220	ALB	CB
R7	0235 5970	1K	ALB	CB
R8	0235 4550	510, ±5%	ALB	CB
R9	0235 4980	36K, ±5%	ALB	CB
R10	0235 4550	510, ±5%	ALB	CB
R11	0235 5970	1K	ALB	CB
R12	0235 5790	33	ALB	CB
R13	0203 4800	1.8K, 1W	ALB	EB
R14 & R15	0235 4550	510, ±5%	ALB	CB
R16	0235 5340	1.1M, ±5%	ALB	CB
R17	0109 2140	variable, 500K, ±20%, .2W (5:1 ADJ)	BNS	3068P1504
R18	0235 5970	1K	ALB	CB
R19	0235 5950	680	ALB	CB
R21	0235 6090	10K	ALB	CB
R22	0235 6330	1M	ALB	CB
TEST POINT				
TP1	4101 2140	green	UCN	119437

NOTES

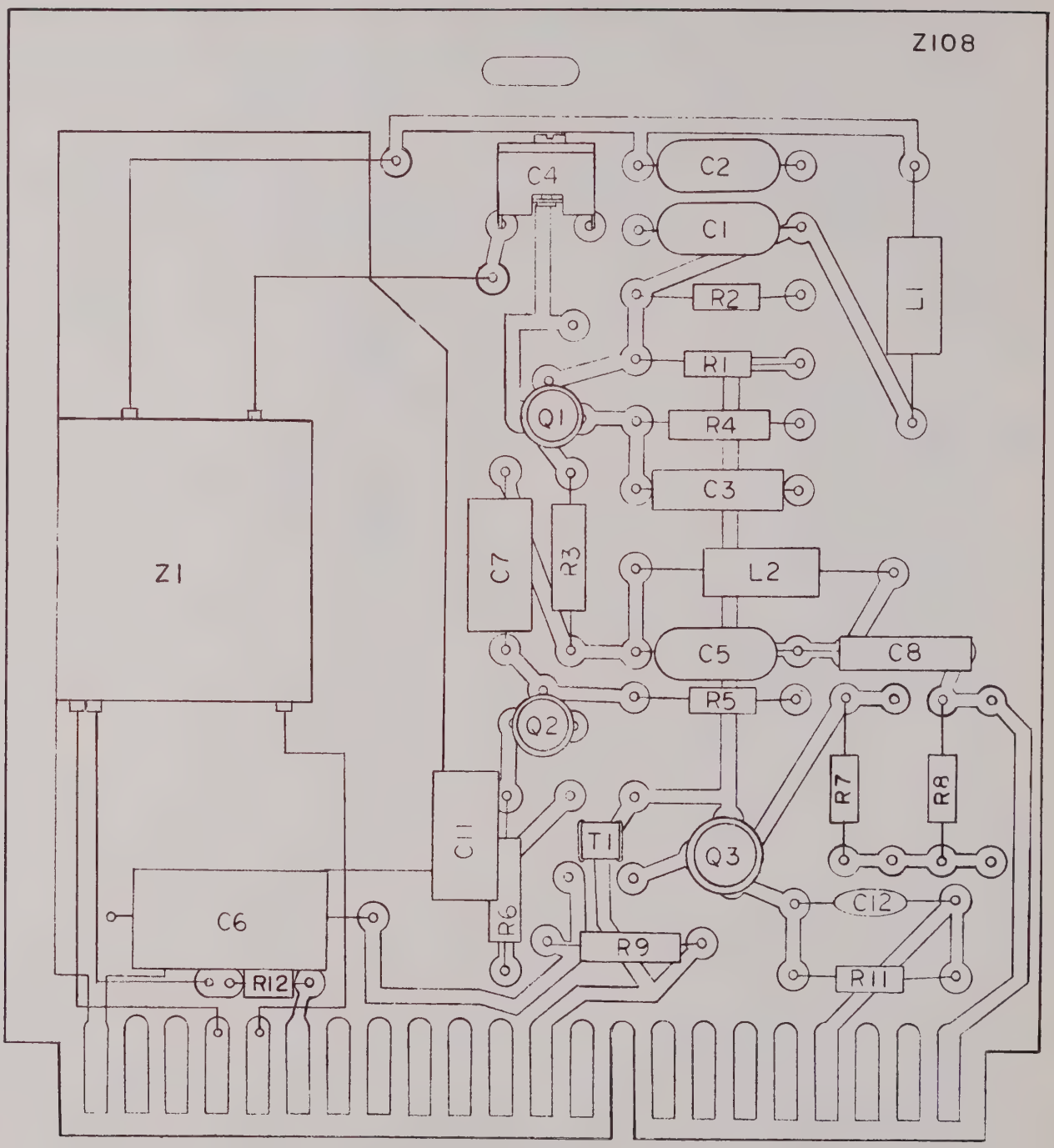


Figure 6-9. Replaceable Components on Modular Card Z108

CAPACITORS

Note: All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.

GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1 & C2	0327 1570	mica, 500 pf, ±1%, 300V	EMC	DM15
C3	0327 3280	0.22 μf, +80 −20%, 25V	SPG	4C41A
C4	0327 3370	variable, 9-35 pf, 100V	ERC	538
C5	0327 1570	mica, 500 pf, ±1%, 300V	EMC	DM15
C6	0326 7630	electrolytic, 10 μf, +100 −10%, 50V	SPG	30D196A1
C7	0316 6650	500 pf, ±10%	ERC	GP2-331
C8	0327 3270	0.1 μf, +80 −20%, 50V	SPG	5C50A
C11	0314 2680	82 pf, ±5%	ERC	331
C12	0326 4520	1000 pf, GMV	ERC	831

COILS

Symbol	Part Number	Description	Recommended Vendor Code	Type
L1	2110 1810	rf, 100 μh, ±5%	SWW	41000
L2	2110 1800	rf, 51 μh, ±5%	SWW	45101

TRANSISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
Q1	2600 7070	DU #2A	FCI	
	2600 7050	alternate, 2N915		
Q2	2600 7020	DU #1A	FCI	
	2600 7000	alternate, 2N914		
Q3	2600 8570	DU #37	FCI	
	2600 8560	alternate, 2N3072		

RESISTORS

Note: All resistors are fixed, composition, ±5%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 4850	10K	ALB	CB
R2	0235 4670	1.8K	ALB	CB
R3	0203 0480	1K, ½W	ALB	EB
R4	0203 0360	330, ½W	ALB	EB
R5	0235 4850	10K	ALB	EB
R6	0203 0320	220, ½W	ALB	EB
R7	0235 4620	1K	ALB	CB
R8	0235 4460	220	ALB	CB
R9*	0203 0620	3.9K, ½W	ALB	EB
	0203 0630	4.3K, ½W	ALB	EB
	0203 0640	4.7K, ½W	ALB	EB
R11	0235 5920	390, ±10%	ALB	CB

* See Schematic Sheet 8, Modular Card Z108 for information.

R12	0203 1530	10, ±10%, ½W	ALB	EB

TRANSFORMER

T1	2001 4682	pulse	ABD	

CRYSTAL ASSEMBLY

Z1	2700 4252	crystal, heater, thermostat	ABD	

NOTES

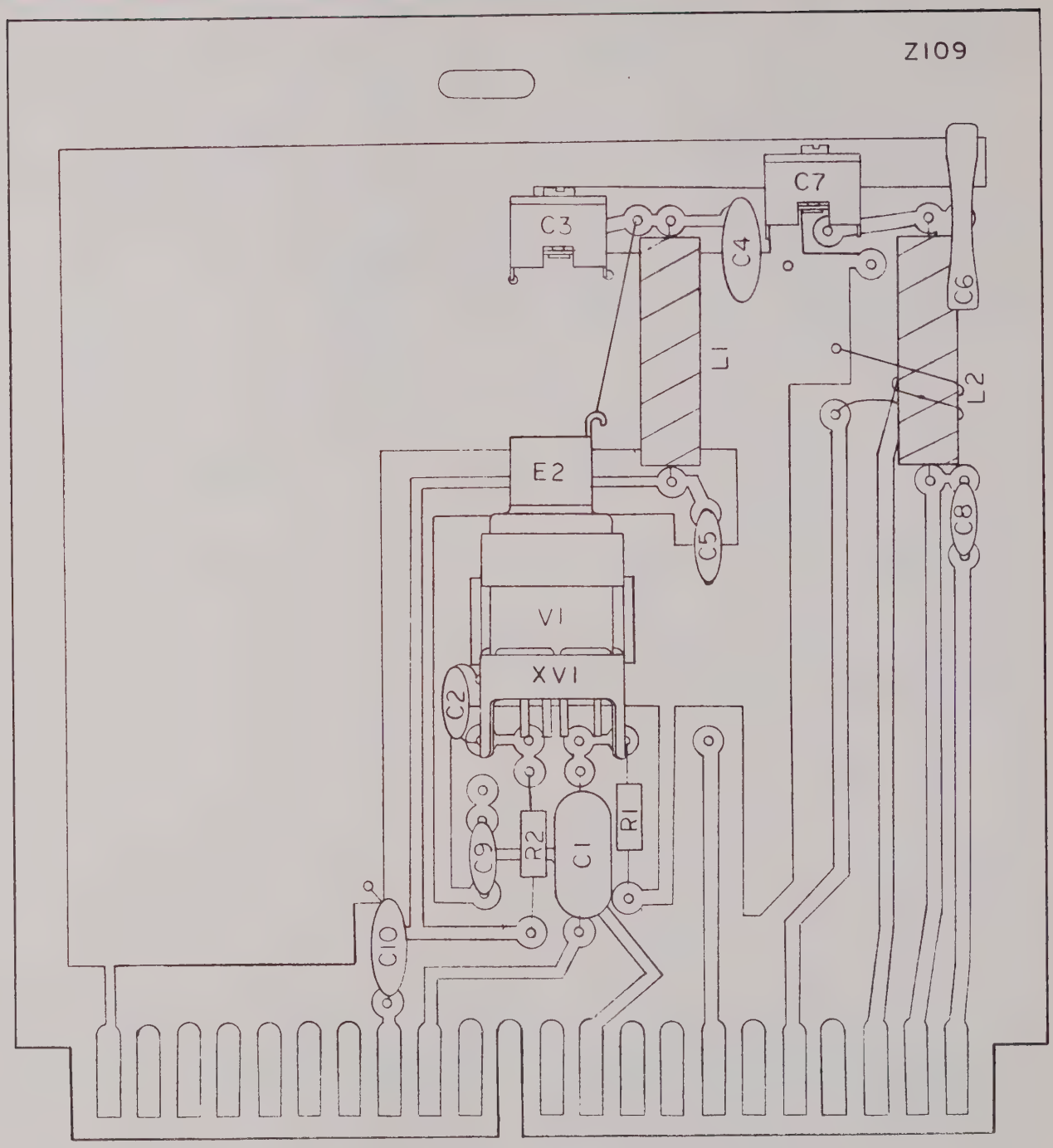


Figure 6-10. Replaceable Components on Modular Card Z109

CAPACITORS

Note: All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.

GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1	0317 5720	mica, 330 pf, ±20%	EMC	DM15
C2	0326 4520	1000 pf, GMV	ERC	831
C3	0327 3370	variable, 9-35 pf, 100V	ERC	538
C4	0316 0310	33 pf, ±5%	EIA	
C5	0326 4520	1000 pf, GMV	ERC	831
C6	0319 5850	27 pf, ±5%	ERC	NPO 332
C7	0327 3370	variable, 9-35 pf, 100V	ERC	538
C8 & C9	0326 4520	1000 pf, GMV	ERC	831
C10	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM

COILS

Symbol	Part Number	Description	Recommended Vendor Code	Type
L1 & L2	2101 2510	rf, 15 μh, ±5%	JWM	4624

RESISTORS

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 4920	fixed, composition, 20K ohms, ±5%, ¼W	ALB	CB
R2	0235 4940	fixed, composition, 24K ohms, ±5%, ¼W	ALB	CB

ELECTRON TUBES

Symbol	Part Number	Description	Recommended Vendor Code	Type
V1	2501 3450	7587	RCA	Nuvistor

NOTES

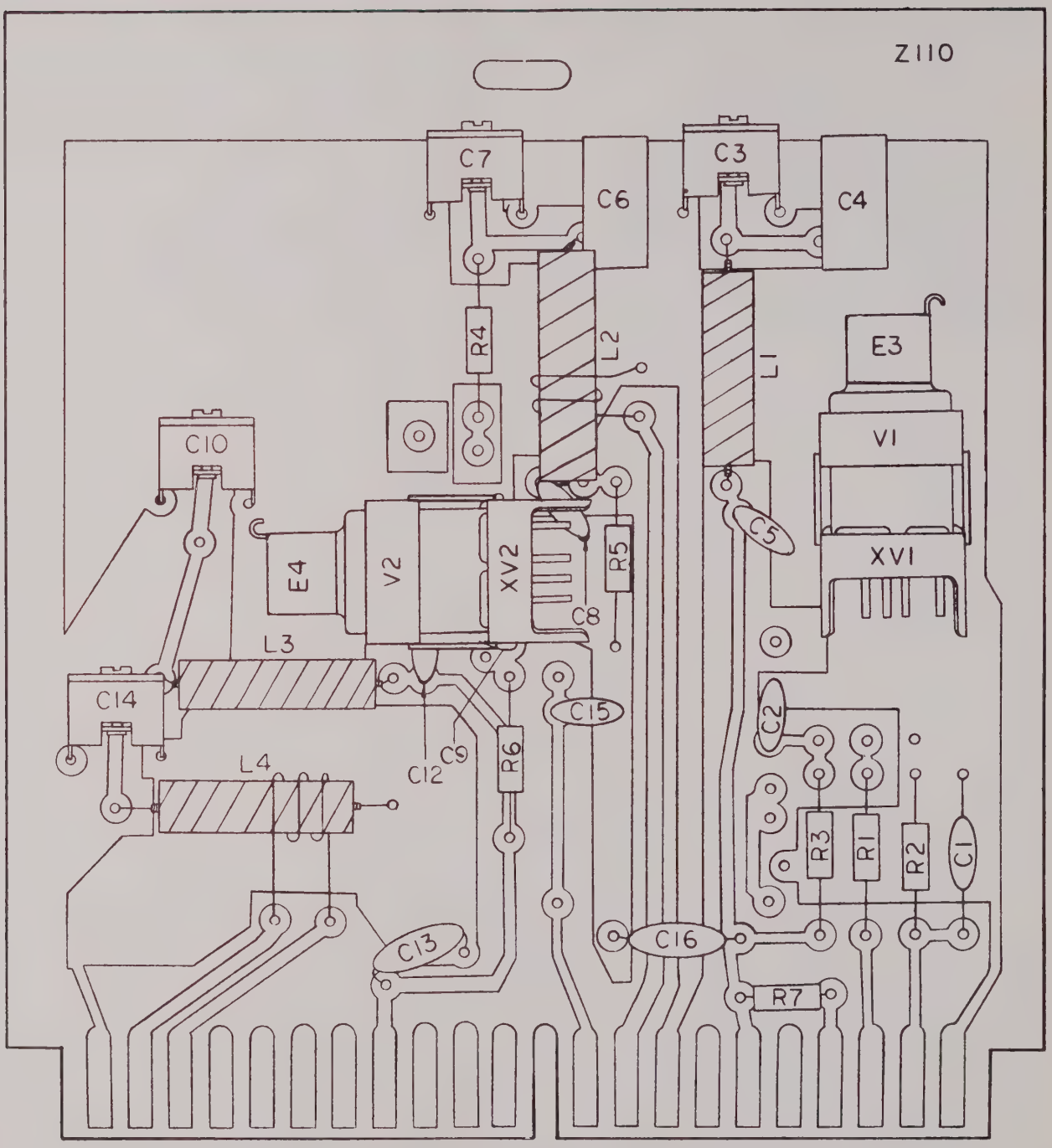


Figure 6-11. Replaceable Components on Modular Card Z110

CAPACITORS

Note: All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.

GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C1 & C2	0326 4520	1000 pf, GMV	ERC	831
C3	0327 3370	variable, 9-35 pf, 100V	ERC	538
C4	0316 7350	12 pf, ±5%	ERC	NPO 331
C5	0326 4520	1000 pf, GMV	ERC	831
C6	0316 7230	6.2 pf, ±0.25 pf	ERC	NPO 331
C7	0327 3370	variable, 9-35 pf, 100V	ERC	538
C8 & C9	0326 4520	1000 pf, GMV	ERC	831
C10	0327 3300	variable, 5.5-18 pf, 200V	ERC	538
C11 & C12	0326 4520	1000 pf, GMV	ERC	831
C13	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C14	0327 3300	variable, 5.5-18 pf, 200V	ERC	538
C15	0326 4520	1000 pf, GMV	ERC	831
C16	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM

COILS

Symbol	Part Number	Description	Recommended Vendor Code	Type
L1	2110 1730	rf, 10 μh, ±5%	JWM	4612
L2	2101 2500	rf, 10 μh, ±5%	JWM	4622
L3 & L4	2110 1720	rf, 0.82 μh, ±20%	JWM	4594

RESISTORS

Note: All resistors are fixed, composition, ±10%, and ¼W. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 4220	22	ALB	CB
R2	0235 5170	220K	ALB	CB
R3	0235 5010	47K	ALB	CB
R4	0235 4220	22	ALB	CB
R5	0235 5170	220K	ALB	CB
R6	0235 4940	24K	ALB	CB
R7	0235 5010	47K	ALB	CB

ELECTRON TUBES

Symbol	Part Number	Description	Recommended Vendor Code	Type
V1 & V2	2501 3450	7587	RCA	Nuvistor

NOTES

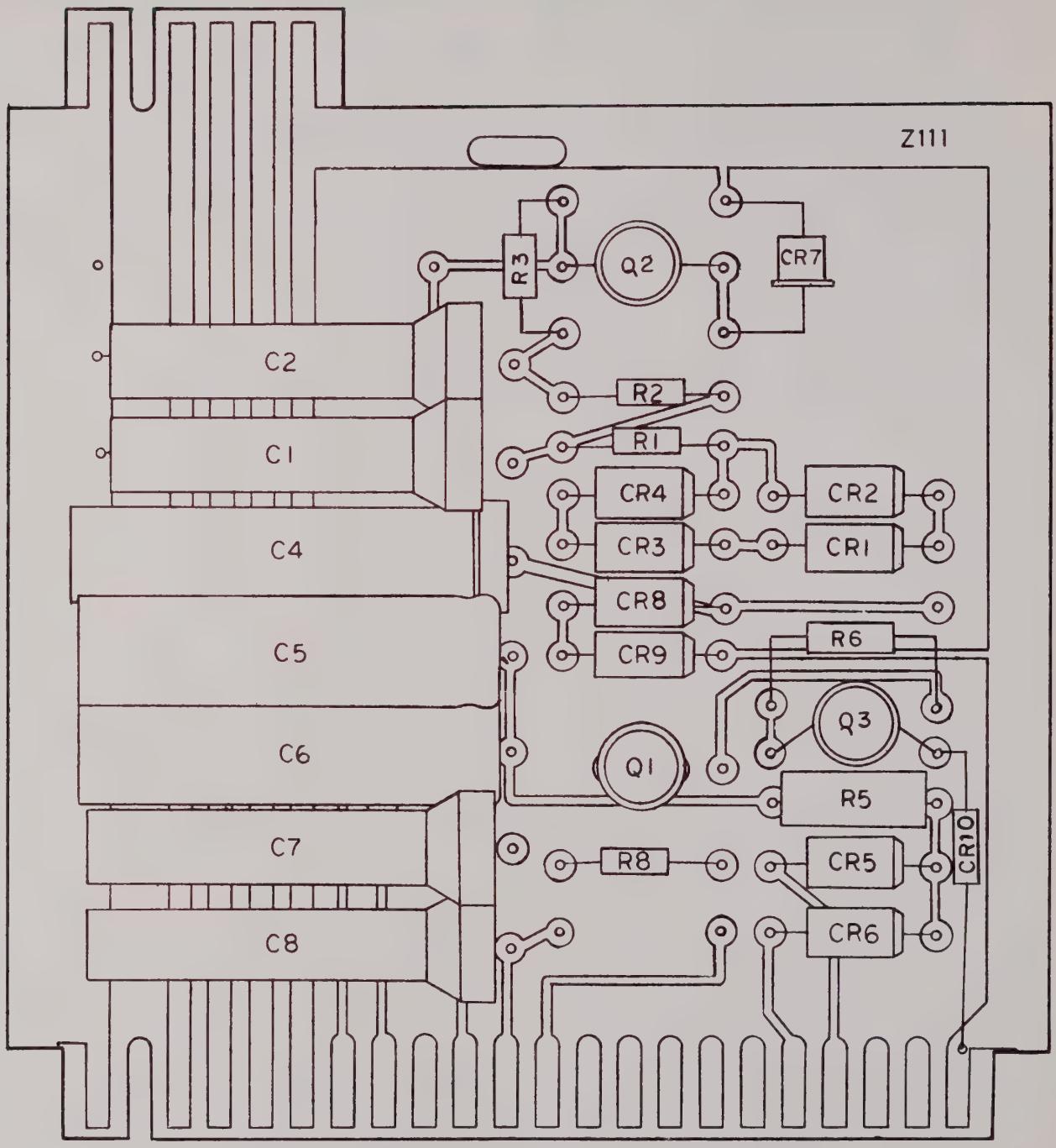


Figure 6-12. Replaceable Components on Modular Card Z111

section 6A — electrical parts list Z111

Symbol	Part Number	Description	Recommended Vendor Code	Type
CAPACITORS				
C1 & C2	0327 3010	electrolytic, 20 μf, +100 −10%, 150V	MAL	TCW
C4	0327 3380	electrolytic, 500 μf, +150 −10%, 3V	MAL	TCW
C5 to C7	0327 3390	electrolytic, 75 μf, +150 −10%, 50V	CDE	NLW
C8	0327 3000	electrolytic, 200 μf, +150 −10%, 12V	MAL	TCW
SEMICONDUCTORS				
CR1 to CR6	2600 7930	diode, CER70	SOL	
CR7	2600 8610	diode, 1N1782-A	EIA	
CR8 & CR9	2600 7930	diode, CER70	SOL	
CR10	2600 8370	diode, G3454	HOF	
TRANSISTORS				
Q1	2600 7260	DU #6	FCI	
	2600 7250	alternate, 2N1893		
Q2 & Q3	2600 7220	DU #5A	FCI	
	2600 7200	alternate, 2N697		
RESISTORS				

Note: All resistors are fixed, composition. Values are in ohms unless otherwise specified; K = thousand, M = million.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R1	0235 4220	22, ±5%, ¼W	ALB	CB
R2	0235 4350	75, ±5%, ¼W	ALB	CB
R3	0237 1010	film, 5.6K, ±5%, 2W	CGW	C42S
R5	0235 1350	4.7, ±5%, 1W	IRC	BWH
R6	0234 9140	film, 2.4K, ±5%, 1W	CGW	C32
R8	0234 7990	film, 120, ±5%, ¼W	CGW	C20

section 6A — electrical parts list Z112

Symbol	Part Number	Description	Recommended Vendor Code	Type
LAMPS				
DS1	1201 0650	incandescent, 6V	DRK	121-7
	1201 2340	lampholder, red		
DS2	1201 0650	incandescent, 6V	DRK	121A-604
	1201 2490	lampholder, green		
FUSE				
F1	1100 0930	0.5 ampere	LFI	313.250
ELECTRICAL CONNECTORS				
J1 to J11	0905 9180	receptacle, female, 22 contacts	CIN	252 22 36 160 (072)
J12 to J19	0903 7410	jack tip, black	UCN	118930
J21 to J26	0903 7410	jack tip, black	UCN	118930
J27	0905 7610	BNC, rf, female, 1 contact	UG	625A/U
J28	0904 4351	receptacle, male, 3 contacts	ABD	
J29	0904 4361	receptacle, female, 6 contacts	ABD	
J30	0905 7610	BNC, rf, female, 1 contact	UG	625A/U
J32	0905 8500	jack, assembly	AMA	403
TRANSISTOR				
Q1	2600 7580	2N1701	RCA	
SWITCHES				
S1	0501 7191	push button (MARKER SELECTOR)	ABD	
S2	0501 7201	push button (TRIGGER RATE)	ABD	
S3	0503 2490	toggle, SPST (POWER ON)	ALCO	MST105D
TRANSFORMERS				
T1	2001 3833	power	ABD	
T2	2001 3841	auto	ABD	

NOTES

SECTION 6B
SPARE PARTS LIST

SPARE PARTS REQUIREMENTS

a. GENERAL

The Type 781 Time-Mark Generator is an extremely reliable and dependable instrument. Only components thoroughly tested and approved by the engineers of the Quality Assurance Laboratory are used in this instrument. Continued performance tests, environmental and life testing of production units make certain your generator will give many years of satisfactory service. These new Fairchild generators are precision engineered and require no selected parts.

Two lists of "running spares" are included to aid you in periodic maintenance. The running-spare parts lists include recommended quantities and reference symbol numbers. Section 6A of this Instruction Manual gives a complete listing of all components and their recommended vendors so that you may readily procure them from a local supply house or your own stores.

Note: The local Fairchild Scientific Instrument Field Engineering representative and his service organization can assist you in obtaining any additional components in the shortest possible time. To help expedite service, always give the Type Number and Serial Number of the instrument; always specify the part number and give a description of the component (see Section 6A of this manual).

b. 500-Hour Spares (6 months)

The recommended list for one through three units follows.

Electron Tubes

Type	Quantity
7587	2

Transistors

2N1701	1
2N914	8
2N915	12
2N1132	8
2N1893	1
2N3072	1

Diodes

FD100	1
FD281	1
FD841	12
1N716	1
CER 70	4
1N1782-A	1
G3454	1

Lamp

Incandescent, 6V	1

Fuse

0.5 ampere	1

c. 2000-Hour Spares (2 years)

The recommended list for one through five units is given below. Maintain spares indicated plus one for each generator in use; 2 of each set of the 500-hour spare list given in paragraph (b) plus the quantities listed as follows:

Modular Card Assemblies

Symbol	Part Number	Description
Z101	8700 1641	5 μsec & 10 μsec
Z102	8700 1651	50 μsec & 100 μsec
Z103	8700 1661	0.5 msec & 1 msec
Z104	8700 1671	5 msec & 10 msec
Z105	8700 1681	50 msec & 100 msec
Z106	8700 1691	500 msec & 1 sec
Z107	8700 1701	5 sec & Trig Buffer
Z108	8700 1711	1 Mc
Z109	8700 1721	5 Mc
Z110	8700 1731	10 Mc & 50 Mc
Z111	8700 1741	Power Supply

Capacitors

Description	Quantity
Variable, ceramic, 9-35 pf, 100V	3
Variable, ceramic, 5.5-18 pf, 200V	2

Coils

RF, 100 microhenrys	1
RF, 51 microhenrys	1
RF, 15 microhenrys	1
RF, 10 microhenrys	1
RF, 0.82 microhenrys	1

Resistors

Variable, composition, 50K, 0.2W	4
Variable, composition, 500K, 0.2W	1

Lamps

Symbol	Description	Quantity
DS1	Red lampholder	1
DS2	Green lampholder	1

Switches

Stock only one each of the following switches for each 6 units being maintained.

S1	Marker Selector Push Button
S2	Trigger Rate Selector Push Button
S3	SPST, toggle

Transformers

T1 (Z101, Z108)	pulse	2
T2 (Z101)	pulse	1
T1 (Z112)	power	1
T2 (Z112)	auto	2

Crystal Assembly

Z1	1

d. Miscellaneous

The following items may be stocked in the quantities indicated for *each* unit being maintained, unless otherwise specified.

NAME	Part Number	Quantity
Jack tip, black	0903 7410	2
Connector, BNC, rf female, 1 contact	0905 7610	1 for each 6 units
Connector, female, 22 contacts	0905 9180	2
Knob, black	4501 1200	3
Knob, red	4501 1210	1 for each 12 units

e. Summary

The quantities of spare parts given in the preceding paragraphs are intended for industrial and military duty under normal environment and heavy-use conditions. It is suggested that the maintenance engineer evaluate:

1. The conditions under which the instruments will be used.
2. The skill of the maintenance technicians.
3. Other similar items on hand.
4. The effect of procurement time of spares and effects of instrument down-time on your organization.

It is recommended that inventories of spare parts outlined above be adjusted according to the requirements of your own laboratory or plant.

In the first analysis, the factory recommends the availability of spares or standby equipments since extensive life testing of your instrument has shown no higher failure rate for any specific component.

NOTES

LIST OF RECOMMENDED VENDORS

CODE	NAME
ABD	Du Mont Laboratories
AER	Aerovox Corporation
AHH	Arrow-Hart & Hegeman Electric Company
ALB	Allen-Bradley Company
ALC	Allied Control
ALCO	Alco Electronic Products
ALD	Alden Products Company
AMA	Amaton Electronic Hardware
AMP	Amp Inc.
AMR	Amperite Company, Inc.
AMX	Amperex Electronics Products, Inc.
APC	American Phenolic Corporation
APH	Amphenol Electronics Corporation
ARC	Arco Electronics Inc. (Elmenco)
AST	Astron Corporation
AUT	Automatic Metal Products Corporation
BEL	Belfuse
BNS	Bourns Inc.
BUR	Burndy Engrg. Company
BUS	Bussmann Mfg. Company
CAN	Cannon Electric Company
CBS	CBS-Hytron Division of CBS
CDE	Cornell-Dubilier Electric Corporation
CGW	Corning Glass Works
CH	Cutler-Hammer, Inc.
CHC	Chester Cable Corporation
CHM	Chatham Electronics
CIN	Cinch Manufacturing Company
CLS	Clarostat Mfg. Co., Inc.
COC	Continental Carbon
COM	Comar Electric
COW	Continental-Wirt Electronics Corporation
CPC	C. P. Clare & Company
CRL	Centralab, Division of Globe-Union, Inc.
CST	Chicago Standard Transformer Corporation
CTC	Cambridge Thermionic Corporation
CTS	Chicago Telephone Supply Corporation
DAG	Dage Electric Company, Inc.
DAL	Dale Products, Inc.
DLC	Dialight Corporation
DRK	Drake Mfg. Company
EBY	Hugh H. Eby, Inc.
EDL	Edal Industries
EIA	Any manufacturer meeting EIA standards
ELC	Electra Manufacturing Company
ELD	Eldema Corporation
EMC	Electro Motive Mfg. Company
EMW	Elmwood Sensors, Inc.
ERC	Erie Resistor Corporation
ESX	Essex Electronics
FAST	John E. Fast Company
FCI	Fairchild Camera and Instrument Corporation
FER	Ferroxcube Corporation of America
GDE	Good-All Electric Mfg. Company
GE	General Electric Company
GEN	General Instrument Corporation
GEP	General Products Corporation
GLB	Globe Industries
GRC	General Radio Company
GRY	Grayhill, Inc.
GUD	The Gudeman Company
HAM	The Hammarlund Manufacturing Co., Inc.

CODE	NAME
HON	Honeywell
HOP	Hopkins Engineering Company
HP	Hewlett-Packard Company
IEC	International Electronics Corporation
IRC	International Resistance Company
IRP	International Rectifier Corporation
ITT	ITT Components Division
JEF	Jeffers Electronics, Inc.
JHN	E. F. Johnson Company
JWM	J. W. Miller Company
KUL	Kulka Electric Mfg. Co. Inc.
KXM	Klixon Metals and Control Corporation
LED	Ledex Inc.
LEE	Leecraft Mfg. Company
LFI	Littlefuse, Inc.
LIN	Line Electric
MAL	P. R. Mallory & Company, Inc.
MCR	Micro Switch (Division of Minneapolis-Honeywell Regulator Co.)
MIC	Micamold Electronics Mfg. Corporation
MIL	Miller Electric Company
MOT	Motorola Semiconductor Products, Inc.
MOV	M-O Valve Company Ltd.
MUC	Mucon Corporation
MUT	The Muter Company
NYT	New York Transformer Company, Inc.
OAK	Oak Mfg. Company
PHC	Philco Corporation
PHI	Philips Electronic Tube Division
PLS	Plastoid Corporation
POT	Potter & Brumfield, Inc.
PRC	Precision Resistor Co., Inc.
PYR	Pyramid Electric Company
RCA	Radio Corporation of America
RMC	Radio Materials Corporation
ROY	Royal Electric Corporation, Inc.
RTN	Rotron Mfg. Company
SIG	Signalite Inc.
SIL	Silicon Transistor Corporation
SLT	Sealectro Corporation
SOL	Solitron Devices, Inc.
SPG	Sprague Electric Company
STC	Stackpole Carbon Company
STW	Standard Winding Company
SUM	Summit Coil Company
SWW	Stanwyck Winding Company
SYL	Sylvania Electric Products, Inc.
SYN	Syntronic Instruments, Inc.
TEC	Transistor Electronics Corporation
TEX	Texas Instruments, Inc.
THC	Thermal Control, Inc.
TOR	Torrington Mfg., Company
TRS	Tresco, Inc.
TRU	Tru-Ohm Products
TUG	Tung-Sol Electric Inc.
UCN	Ucinite Company
UTC	United Transformer Company
VIC	The Victoreen Instrument Company
WDE	Wood Electric Corporation
WDL	Ward Leonard Electric Company
WES	Weston Electrical Instrument Corporation
WYN	Welwyn International Inc.

NOTES

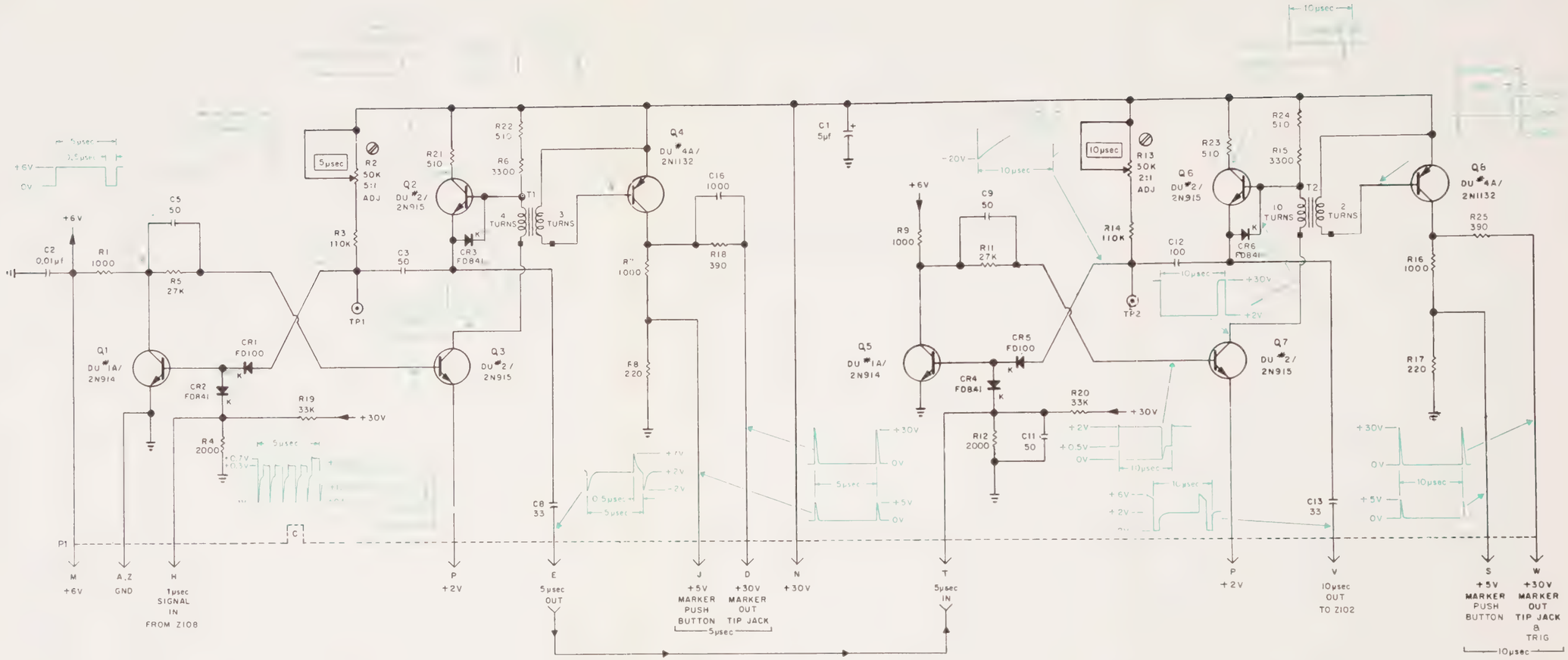
SECTION 6C
SCHEMATICS

MODULAR CARD	SCHEMATIC
Z101	5 μsec and 10μsec
Z102	50 μsec and 100 μsec
Z103	0.5 μsec and 1 msec
Z104	5 msec and 10 msec
Z105	50 msec and 100 msec
Z106	500 msec and 1 sec
Z107	5 sec and Trigger Buffer
Z108	1 Megacycle Crystal Oscillator
Z109	5 Megacycle Output
Z110	10 Megacycle and 50 Megacycle Output
Z111	Power Supply
Z112	Main Frame and Mother Board

NOTE

The following twelve schematics comprise the Type 781A Time-Mark Generator.

NOTES



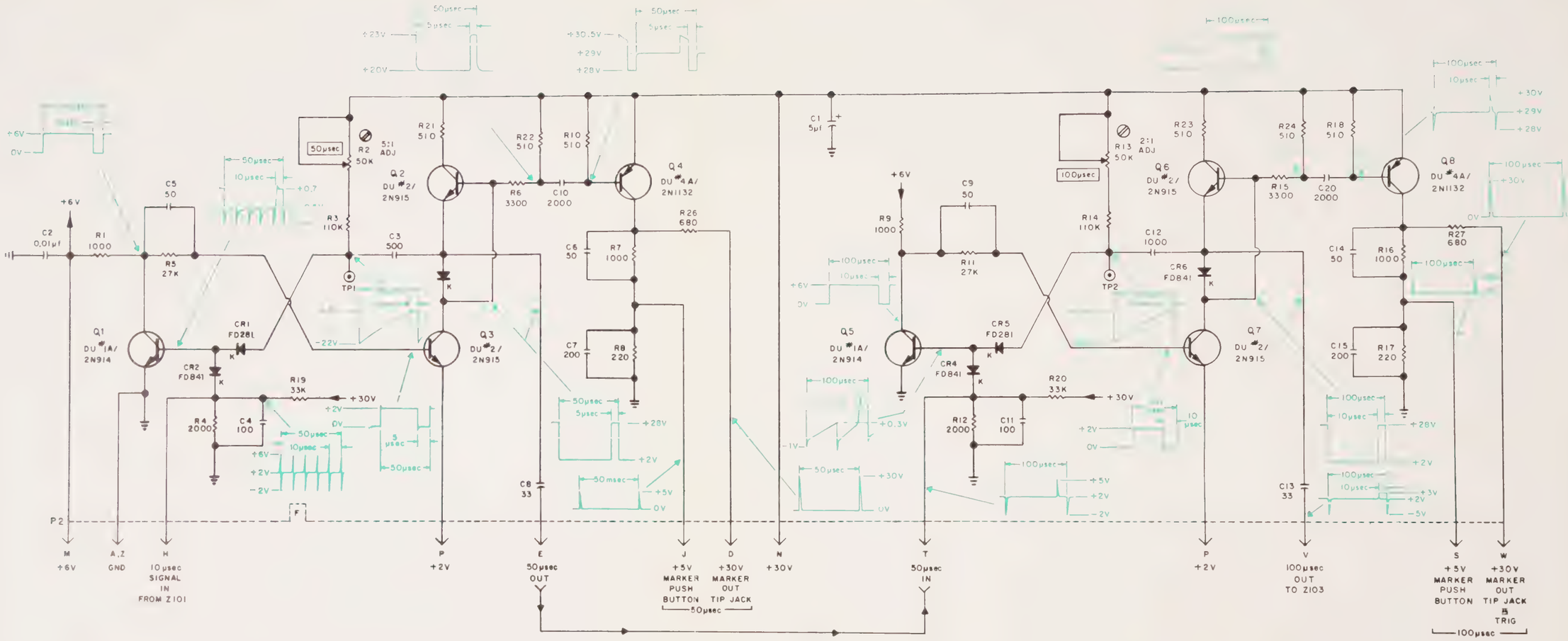
NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K = THOUSAND, M = MILLION.
2. CAPACITANCE VALUES ARE pf UNLESS OTHERWISE SPECIFIED.

WAVEFORM DATA

1. Use Type 4290 Series Probe (X10).
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc.
3. Nominal waveform amplitude given.

TYPE 781A TIME-MARK GEN. (5 μsec & 10 μsec)

SHEET 1 of 12



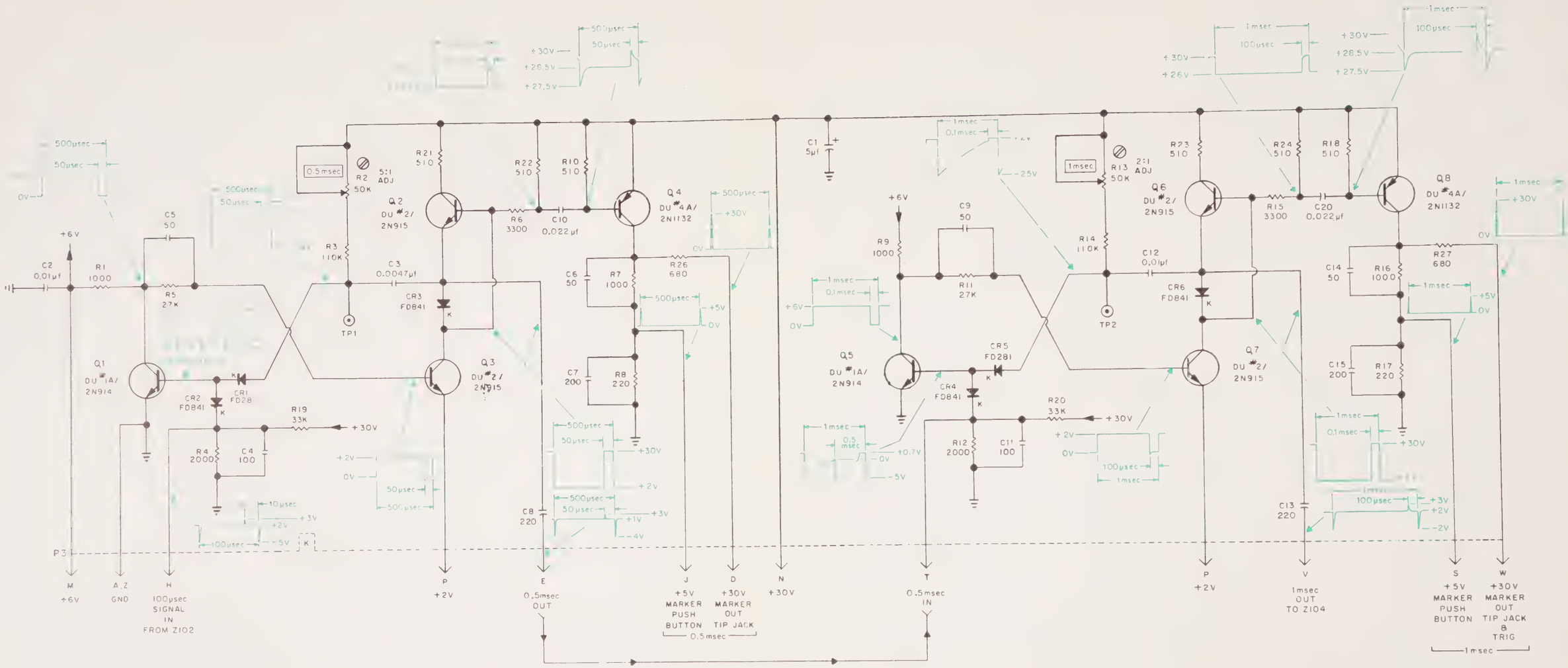
CARD
Z102

NOTES:
1. RESISTANCE VALUES ARE IN OHMS;
K = THOUSAND, M = MILLION.
2. CAPACITANCE VALUES ARE pf
UNLESS OTHERWISE SPECIFIED.

WAVEFORM DATA

1. Use Type 4290 Series Probe (X10).
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc.
3. Nominal waveform amplitude given.

TYPE 781A TIME-MARK GEN. (50 μsec & 100 μsec)
SHEET 2 of 12

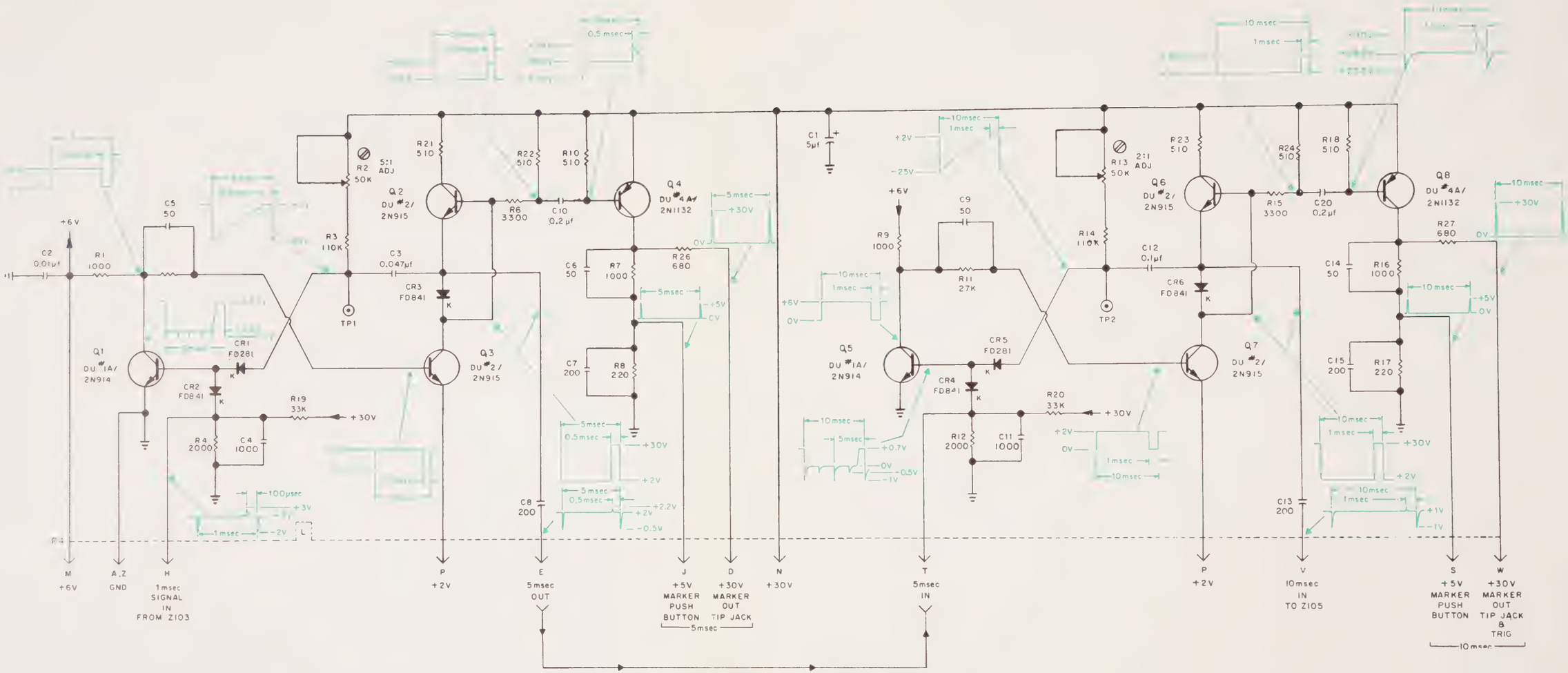


CARD 1
Z103

NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K = THOUSAND, M = MILLION.
2. CAPACITANCE VALUES ARE pf UNLESS OTHERWISE SPECIFIED.

WAVEFORM DATA

1. Use Type 4290 Series Probe (X10).
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc.
3. Nominal waveform amplitude given.



CARD Z104

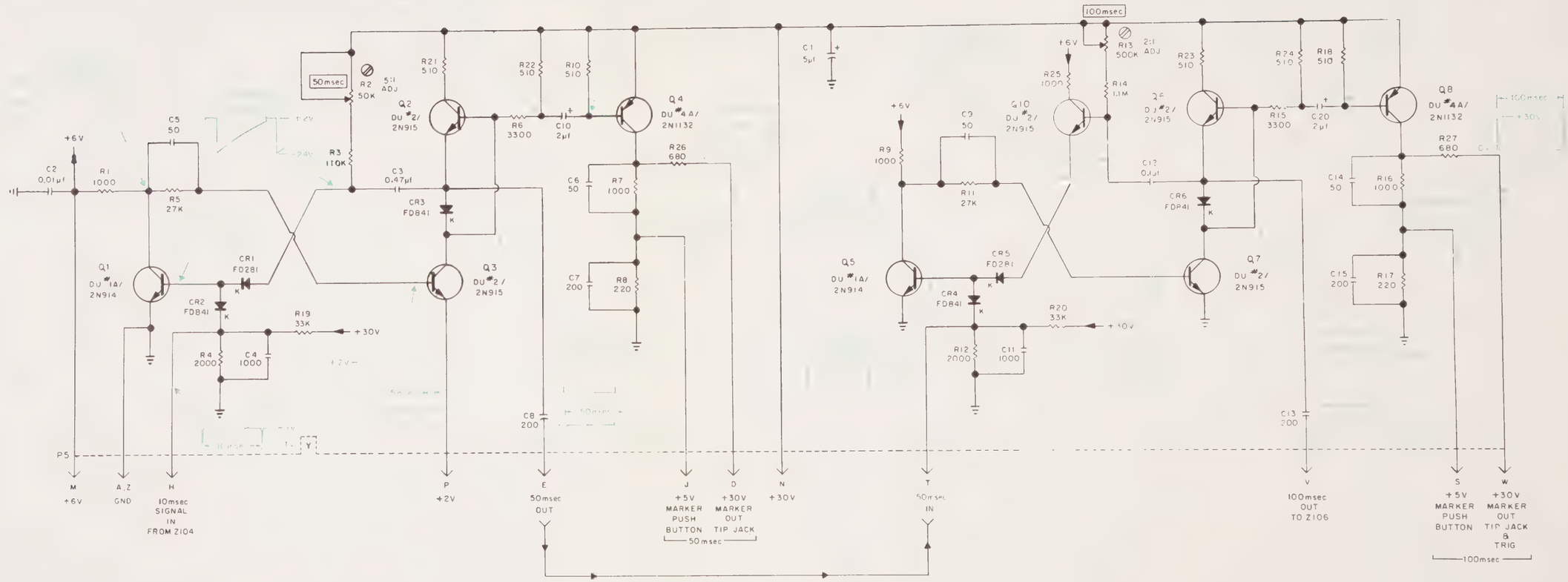
NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K = THOUSAND, M = MILLION.
2. CAPACITANCE VALUES ARE pf UNLESS OTHERWISE SPECIFIED.

WAVEFORM DATA

1. Use Type 4290 Series Probe (X10).
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc.
3. Nominal waveform amplitude given.

TYPE 781A TIME-MARK GEN. (5 msec & 10 msec)

SHEET 4 of 12



NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K= THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE pf UNLESS OTHERWISE SPECIFIED.

WAVEFORM DATA

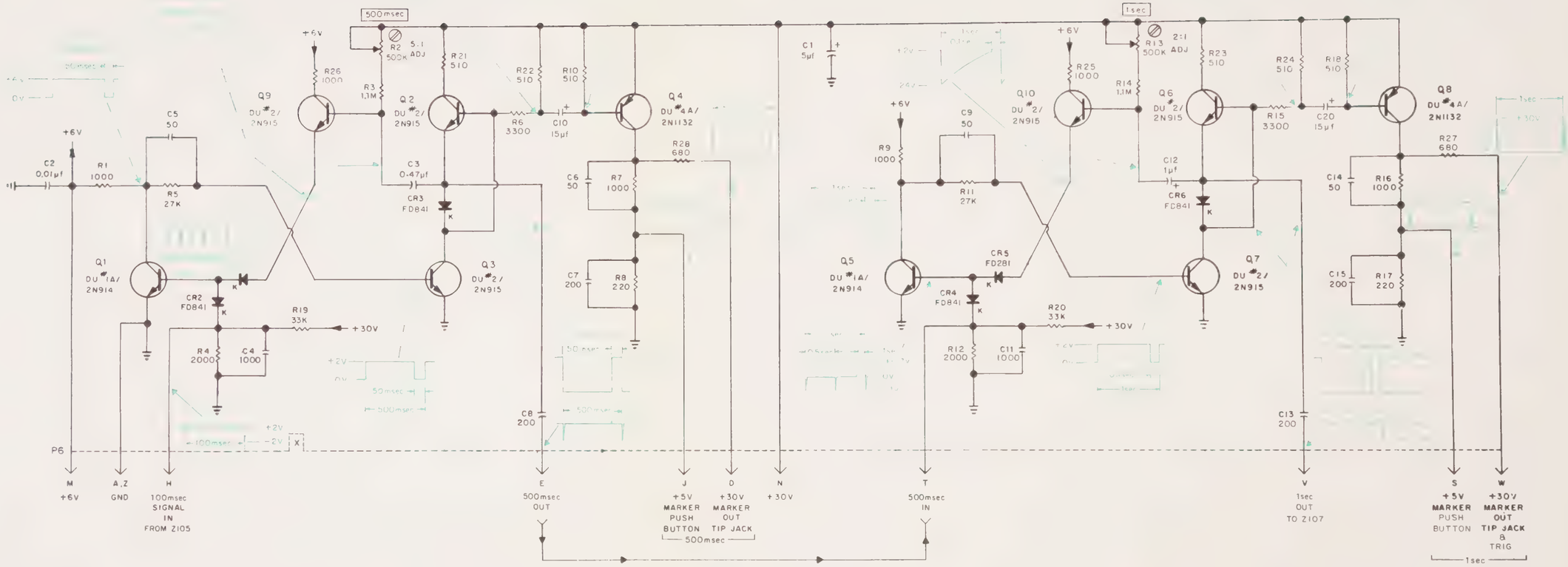
e Type 429 Series Probe (X10)

2. Use Type 765 Series Test Oscilloscope dc to 50 M

3. Nominal waveform amplitude given

TYPE 781A TIME-MARK GEN. (50 msec & 100 msec)

SHEET 5 of 12



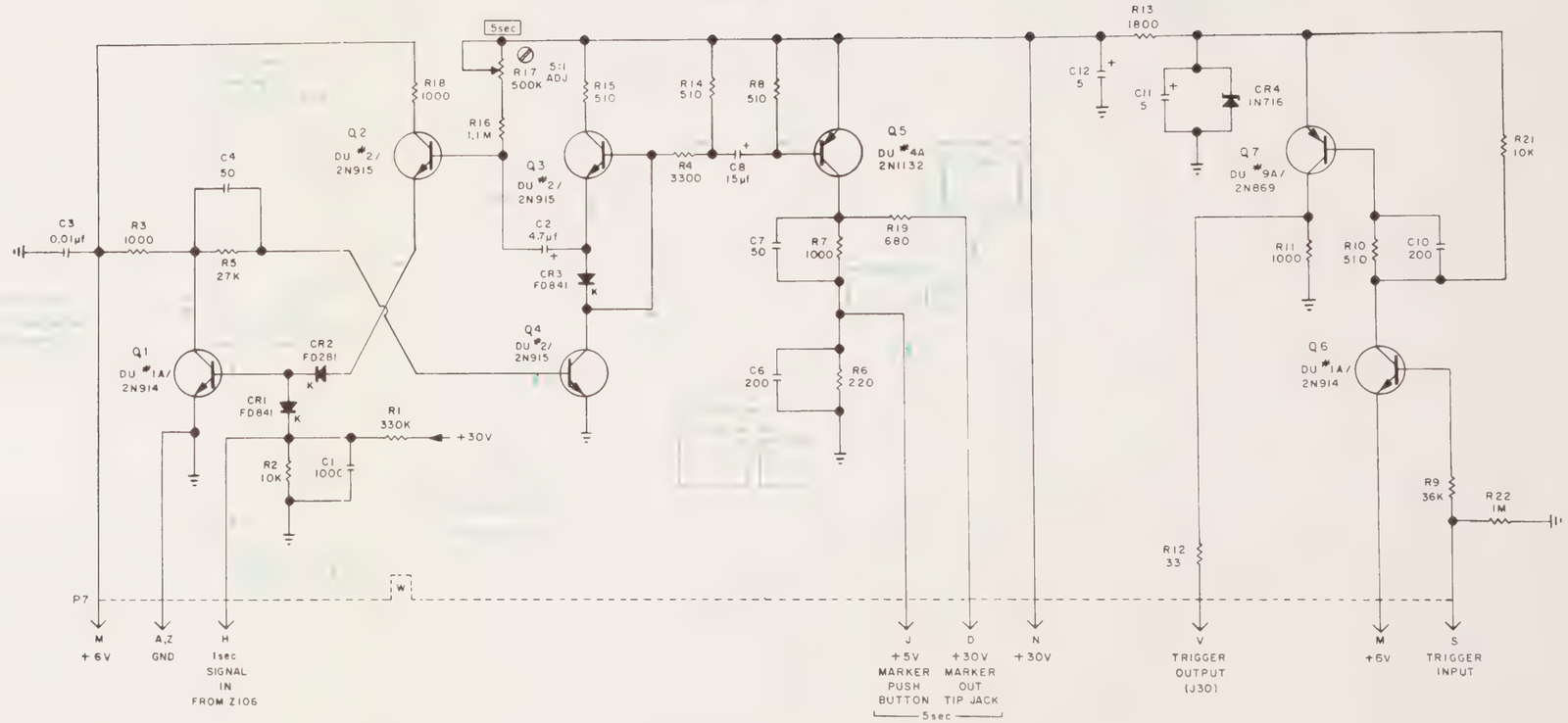
NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.

WAVEFORM DATA

1. Use Type 4290 Series Probe (X10)
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc.
3. Nominal waveform amplitude given

TYPE 781A TIME-MARK GEN. (500 msec & 1 sec)

SHEET 6 of 12



NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K = THOUSAND, M = MILLION.
2. CAPACITANCE VALUES ARE pf UNLESS OTHERWISE SPECIFIED.

WAVEFORM DATA

Use Type 4290 Series Probe (X10)

2 Use Type 765 Series Test Oscilloscope, dc to 50 Mc

3. Nominal waveform amplitude given

TYPE 781A TIME-MARK GEN. (5 sec & TRIG. BUFFER)

SHEET 7 of 12

*R9 IS 4.3K (NOMINAL)
3.9K, 4.3K & 4.7K ARE
SELECTED TO OBTAIN
PROPER Q3 COLLECTOR
WAVEFORM AS SHOWN

P8

N +30V

C8
0.1μf

+33V
+30V
+29V

C6
10μf

*R9

T1

+4V

3
TURNS

3
TURNS

Q3
DU #37/
2N3072

1μsec

+5V
+2V

+4V
0V

1μsec

R6
220

+3V

C11
82

H CARD Z101

K CARD Z109

W J12

S PUSH BUTTON

1Mc OUTPUT

C7
500

Q2
DU #1A/
2N914

C12
1000

R11
390

R7
1000

R1
10K

R3
1000

R5
10K

Q1
DU #2A/
2N915

C4
9-35
1Mc
FREQ
ADJ

0.1μsec

R8
220

A

Z

C1
500

R2
1800

R4
330

C3
0.22μf

CRYSTAL OVEN
Z1

L1
100μh

4

1 GRN

CRYSTAL HEATER LAMP

R12
10

S1

Y1

HEATER

R

2 RED

E

6.3V AC

3 BLK

D

C2
500

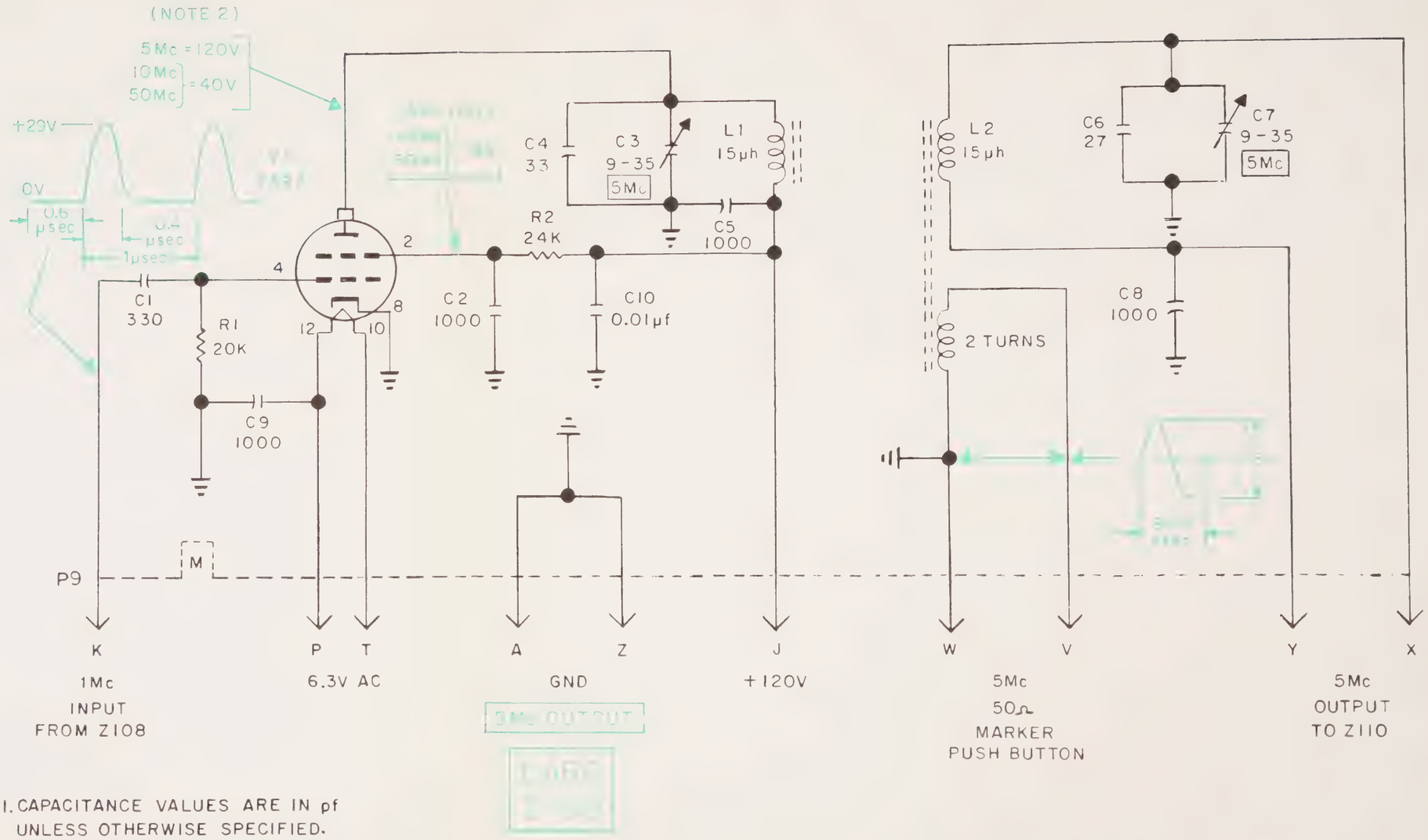
5

1Mc CRYSTAL OSCILLATOR

CARD Z108

NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.

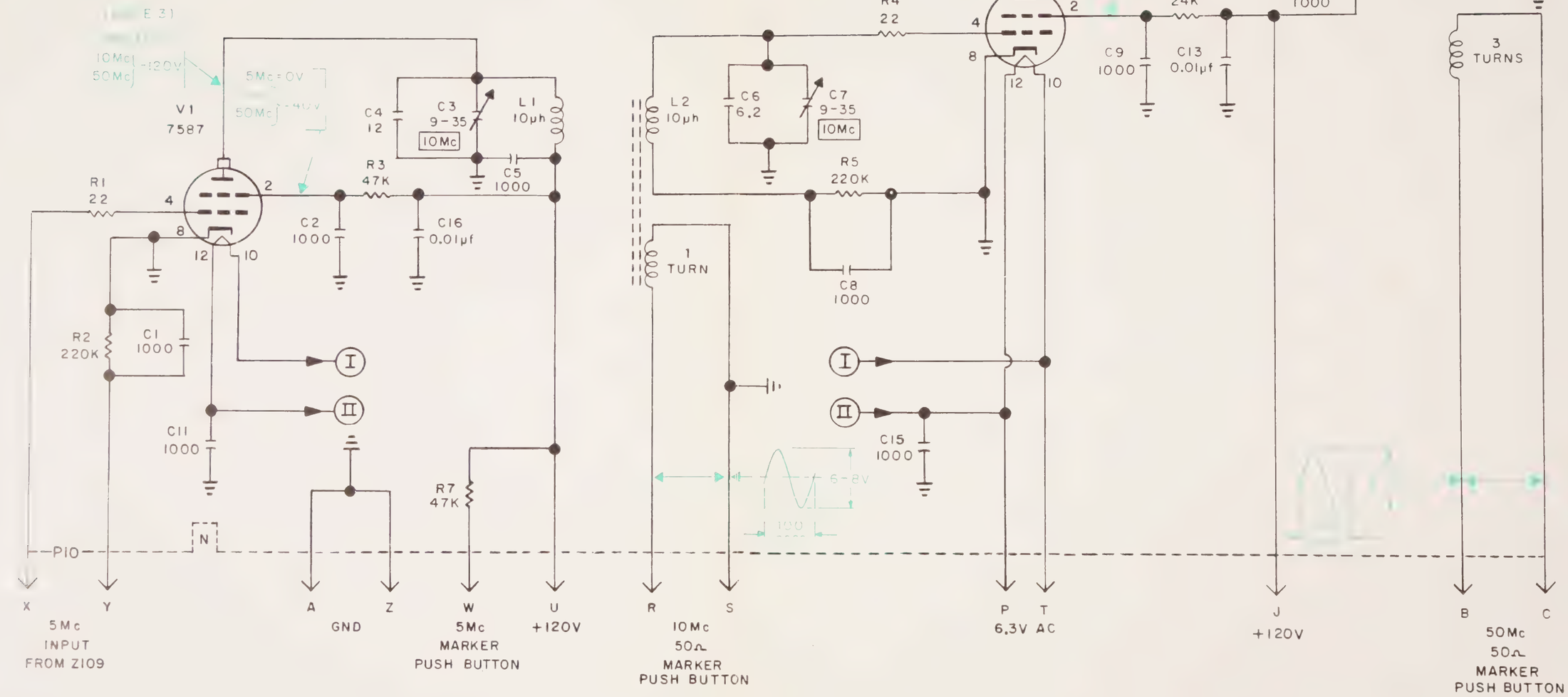
1. Use Type 4290 Series Probe (X10)
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc
3. Nominal waveform amplitude given.



1. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
2. DESIGNATED PUSH BUTTONS (5, 10, 50Mc) SELECTS GIVEN VOLTAGE AT POINTS SHOWN.

WAVEFORM DATA

1. Use Type 4290 Series Probe (X10)
2. Use Type 765 Series Test Oscilloscope, dc to 50 Mc
3. Nominal waveform amplitude given



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K = THOUSAND, M = MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. DESIGNATED PUSH BUTTON (5, 10 OR 50Mc) SELECTS GIVEN VOLTAGE AT POINTS SHOWN.

10Mc

CARD Z110

50Mc

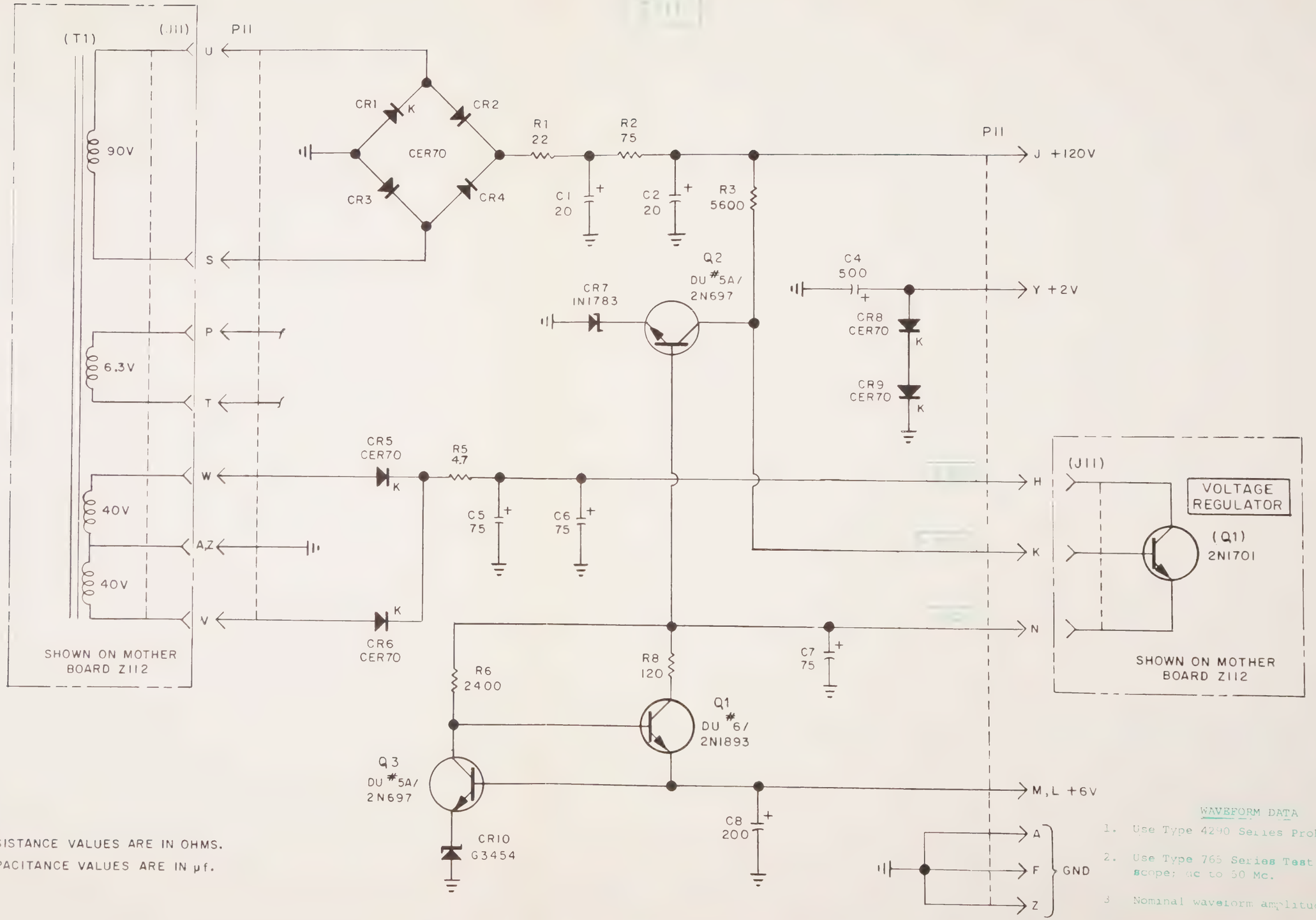
WAVEFORM DATA

1. Use Type 4290 Series Probe (X10).
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc.
3. Nominal waveform amplitude given.

TYPE 781A TIME-MARK GEN. (10 Mc & 50 Mc)

SHEET 10 of 12

POWER SUPPLY



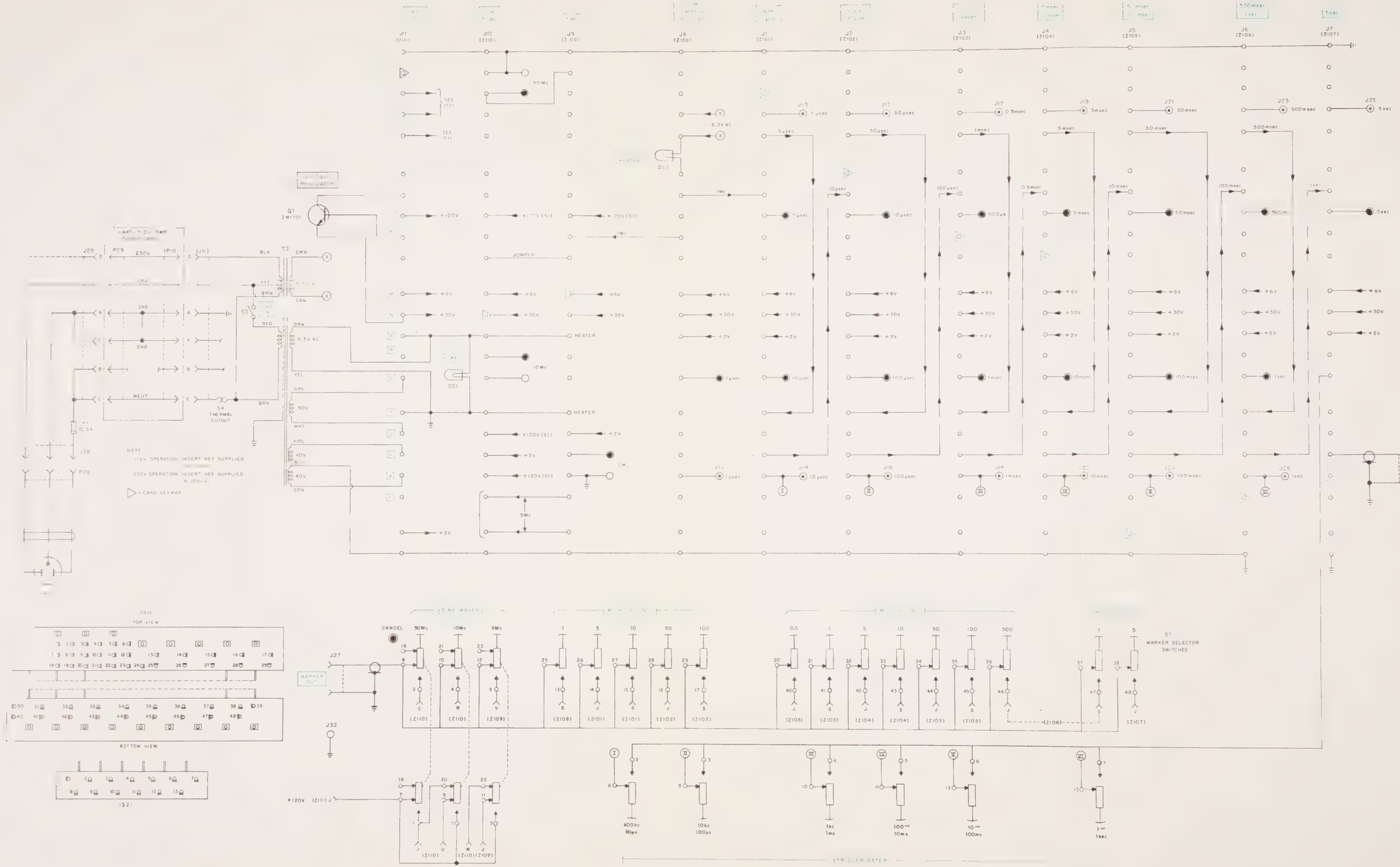
NOTES:
1. RESISTANCE VALUES ARE IN OHMS.
2. CAPACITANCE VALUES ARE IN μf.

WAVEFORM DATA

1. Use Type 4290 Series Probe (X10).
2. Use Type 765 Series Test Oscilloscope; dc to 50 Mc.
3. Nominal waveform amplitude given.

TYPE 781A TIME-MARK GEN. (POWER SUPPLY)

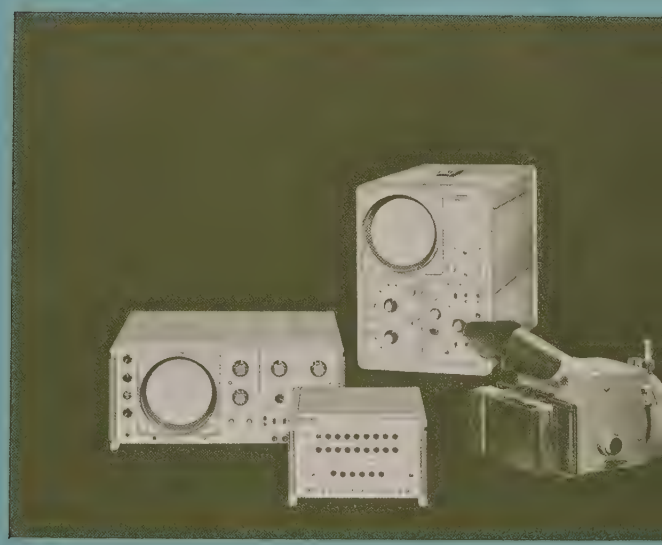
SHEET 11 of 12



TYPE 781A TIME-MARK GEN. (MOTHER BOARD)

SHEET 12 of 12

SCIENTIFIC INSTRUMENTS



SHORT FORM CATALOG • NUMBER 131

FAIRCHILD

INSTRUMENTATION

SCIENTIFIC INSTRUMENT DEPARTMENT

TYPE 700 X-Y INDICATOR

low cost ■ self calibrating ■ 1° phase shift between X & Y axis (DC-100 kc) ■ 10 x 10 cm display ■ identical X & Y amplifiers ■ —40°C to 85°C storage, 0°C to 50°C operating

Sensitivity—100 mv/cm, 2 cal positions, 1V & 10V/cm
Bandwidth—350 kc both X-Y
Phase Shift—at cal gain X-Y adjustable to ±1° from DC to 100kc, when 0° @ 50 kc ±3°
Stability—less than 2 mm drift avg/8 hrs (controlled amb & line voltage)
Z Axis—Option Z axis input —25V to blank trace, Kit 7088
Power—115 or 230V uses approx 85W, 48-450 cps
Input—1 meg shunted by 45 pf

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5 cm) D, 26.5# **$420.00**

TYPE 701 GENERAL PURPOSE SCOPE

10mv/cm ■ DC-500 kc BW ■ 10 x 10cm display ■ under 30 pounds ■ X1 to X10 continuous expansion ■ easy-lock trigger circuits ■ semiconductor amplifier stability

Vertical Amplifier—10mv to 10V/cm in 4 decade steps, control for 10-1 sensitivity adjust, com mode reject exceeds 100-1 (40db), sig ampl should not exceed 6V p-p (±3V DC), X-Y adjustable ±1° DC to 100 kc, 1 meg x 47pf
Horizontal Amplifier—10mv to 10V/cm sensitivity, 2 cals .1V/cm & 1V/cm, 10-1 variable for range .1V to 10V/cm continuous adjust; DC to 350 kc BW, down 3 db
Time Base—Sweep cal 5μs to 200ms/cm in 15 steps 1,2,5 sequence, pull variable extends slowest to 1 sec/cm, cont expand X1 to X10, fastest .5μs/cm
Other—115V or 230V line, 145W const line freq 48-450 cps, 0° to 50°C operate, bench or rack use

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5cm) D, 29.5# **$450.00**

TYPE 702 DUAL TRACE SCOPE

10mv/cm ■ DC to 500kc BW ■ bench or rack ■ 10 x 10cm display ■ dual trace ■ transistorized amplifier stability ■ trigger circuits lock easily ■ modular design

Vertical Amplifier—10 mv to 10V/cm sensitivity, 4 decade steps, 1meg by 44pf single ended; operates ChA only, ChB only, chop, A±B, —2mv drift/hr
Horizontal Amplifier—.1 to 10V/cm sensitivity, variable extends range to 10V/cm
Time Base—Sweep cal 5μs—200ms/cm, 15 steps 1,2,5 seq, 3% accuracy; cont exp X1 to X10, fastest to .5μs/cm, 50 cps auto sync, ±10V trigger level control on external
Display—5" flat face CRT, high brightness, int graticule option, 2.5kv accel potential, push button beam finder, Z axis option (Kit 7088)
Other—115 or 230V power, 175W, 48-450 cps, 0° to 50° operate

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5cm) D, 29.5# **$660.00**

TYPE 704 HI GAIN X-Y SCOPE

matched X-Y amplifiers ■ 200μv/cm ■ DC-500 kc BW ■ 10 x 10cm display ■ balanced or single-ended input all ranges ■ X50 sweep expand ■ simple panel controls ■ electrometer input for amplifier stability

Amplifiers—200μv to 20V/cm sensitivity, 16 steps 1,2,5 seq, 2½-1 variable between 200μv and 50V/cm; DC-500kc down 3db; selector switch for A only, -B only, Diff A-B; 5cm cal sig built-in, 3% accuracy; 100-1 (40db) CMR from .2-20mv/cm, at least 20db all other; phase shift X-Y adjusts to ±1° DC to 100kc; DC or AC coupling, input sig 600V p-p or DC; input impedance 1meg x 50pf single-ended, 2meg x less than 40pf balanced input
Time Base—Sweep cal 5μs to 2sec/cm, 18 steps 1,2,5 seq, 3% accuracy, variable extends slowest sweep to 6sec/cm; 6-step sweep expander from X1 to X50, accurate to 5% for rates to 1μs/cm; trigger from int, ext & line on pos or neg slopes; trigger on 5mm of vert deflection and 500mv p-p ext; auto sync @ 50cps; ±10V trigger leveling on external
Display—5" flat faced CRT, mono-accel high brightness, deflection unblanking; P31 phos (P2,7,11 on request); accel potential 2.5kv; push button beam finder; Z axis option with Kit 7088
Other—115 or 230V, 170W, 48-450cps; —40° to 85°C stored, 0° to 50°C operate

7⅝" (19.3cm) H x 16¾" (42.5cm) W x 19½" (49.5cm) D, 32# **$645.00**

TYPE 403-B HI SENSITIVITY SCOPE

50μv/cm ■ .7μs risetime ■ AC stability control ■ 10 x 10cm display ■ 5kv CRT ■ most sensitive scope commercially available ■ exceptional stability

Vertical Amplifier—50μv/cm-20v/cm sensitivity in 17 cal steps, DC coupled; input imp 1 meg x 47pf; AC stabilizer control for drift-free input; stable to 500μv/hr over 8 hrs; diff input all ranges, 2meg shunted by under 47pf; CMR 100-1 (40db)
Horizontal Amplifier—10mv/cm to 100V/cm sensitivity in 4 decade steps, DC-500kc down 3 db, DC coupled; input imp 1 meg x 47pf; under 1mv/hr drift over 8 hrs
Time Base Generator—Sweep 1μs/cm-5sec/cm 21 cal steps, vernier extends slowest to 25sec/cm; X5 expander extends fastest to .2μs/cm; sync from int, ext & line on + or — slopes (auto-trigger available); trigger sensitivity 5mm of vert deflection @ 250mv p-p ext; ±12v trigger level
Other—K1931 5kv CRT, P31 phosphor (P1,2,7,11 available); metallized screen option for max light output; 115/230v, 48-450 cps, 230w

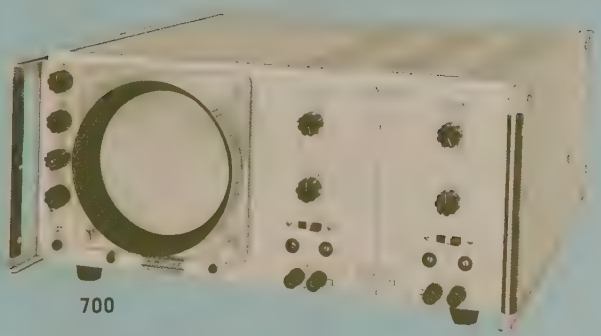
8¾" (22.3cm) W x 15½" (39.4cm) H x 23¼" (59.2cm) D, 45# **$760.00**

Rack Mount—Type 403-BR (front panel input terminals duplicated rear of rack unit)

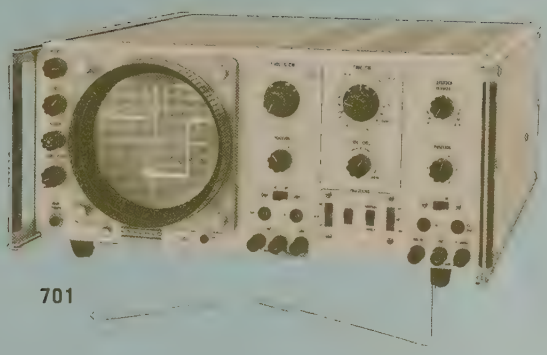
19" (48.4cm) W x 7" (17.8cm) H x 21¼" (53.9cm) D, 45# **$760.00**

FAIRCHILD

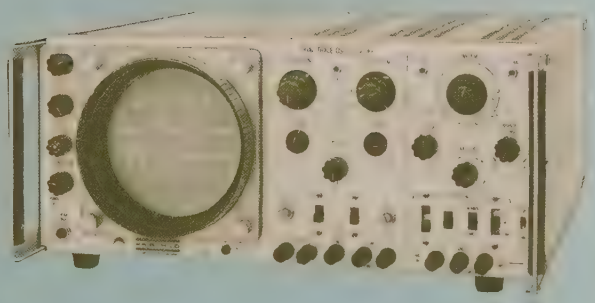
Types
700
701
702
704
403-B
403-BR



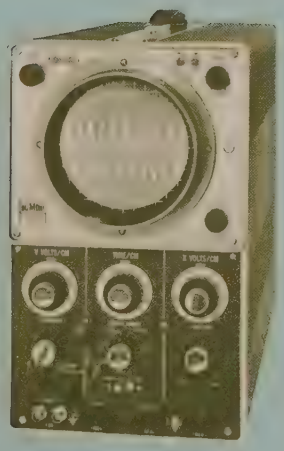
700



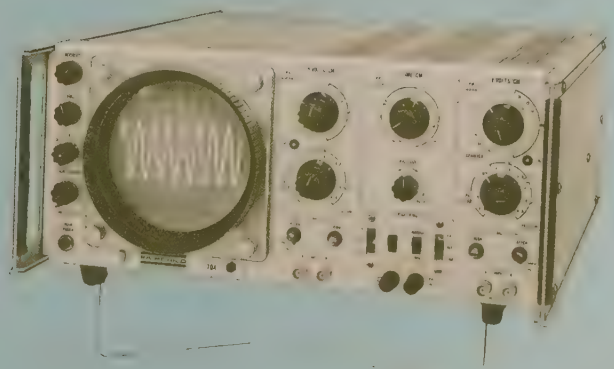
701



702



403-B



704

TYPE 765-H SOLID STATE HIGH FREQUENCY SCOPES

13kv acceleration ■ 6 x 10 cm display ■ 200w consumption ■ silicon circuitry ■ dual plug-ins (DC to 100 mc) ■ X & Y plug-ins interchangeable ■ CRT and power supply in main frame ■ signal circuitry in plug-ins ■ extreme reliability in all environments ■ 48-450cps line ■ no fan

Display—5" flat face post accelerator CRT, 13kv potential; frame grid gives minimum defocusing and spot size; P31 phosphor (P2,7,11 option); 5kv post accel CRT or internal graticule on request; CRT grid accessible thru connectors at rear; 360° joystick positioning of CRT display
Temperature— −40° to +85°C stored, 0° to +50°C operate; thermostat cuts power when ambient limits are exceeded
Humidity—95% @ 40°C; intermittent all conditions without condensation
Vibration and Shock—Vibration 15-min cycle 10-33cps, 3 planes 15-min each 2G limit; Shock 10G for 25ms
Altitude—15,000′ oper, 50,000′ non-oper 5kv; 10,000′ oper, 50,000′ non-oper 13kv units

8¼" (21cm) H x 16¾" (45cm) W x 23" (58.5cm) D, 27# net, 37# shipping; **Type 765H** **$720.00**
Type 765 with 5kv option **$645.00**
Type 765 H/F with (Y Axis Termination option) **$800.00**

Type 766H
13¾" (35cm) H x 9¾" (24.8cm) W x 20⅝" (52.5cm)
Main Frame Type 766H **$595.00**
Type 766 with 5kv option **$545.00**

Type 767H
7" (17.8cm) H x 16⅜" (41.5cm) W for 19" rack x 20" (51cm) D behind panel; Main Frame Type 767H.. **$695.00**
Type 767 with 5 kv option **$550.00**
Type 767 H/F with (Y Axis Termination option) **$770.00**

TYPE 757 HI WRITING RATE SCOPE

Normal and hi writing rate ■ lowest cost on market ■ use all 76-00 and 74-00 plug-ins ■ DC to 100 mc, Tr 3.5ns ■ 7" rack height ■ 4 x 5 cm scan (14kv) ■ solid state circuitry ■ horizontal scan 10 div of 4mm each ■ 150 line vertical and 175 line horizontal resolution ■ normal to fast single shot switch ■ CRT beam cutoff cuts film fog on time exposure

Display—5" flat faced post accel CRT, 14kv accel poten, 8-10mil spot, P11 phosphor for max photo efficiency
Z Axis—Connectors at rear give access to CRT grid
Temperature— −40° to +85°C stored; 0° to +50°C operate; thermostat cuts power when ambient limits reached
Altitude—10,000′ operational, 50,000′ non-operational
Power—115/230v, 200w, 48-450cps

7" (17.8cm) H x 16⅜" (43cm) W x 21" (54cm) D, 27#.net, 37# shipping; Main Frame **$950.00**

TYPE 765-MH MILITARIZED PORTASCOPE

rugged ■ meets MIL specs ■ 48-450 cycles ■ low power use ■ −30° to +60°C ■ solid state circuitry ■ light and portable ■ RFI shielded ■ vibration tested ■ certificate of compliance included ■ FSN 6625-056-7115 ■ fiberglas case ■ carrying handle ■ fiberglas cover for mounting accessories ■ two cavities for X & Y plug-ins ■ electrically identical to 765H series

Heater Strips—200w thermostatic heater for low temp below 0°C
Temperature— −40° - +85°C stored, −30° to +50°C oper without fan, −30° to +60°C oper with fan (mod 101)
Altitude—15,000′ oper, 50,000′ non-oper
Humidity—95% relative @ 40°C, MIL 202B method 106A except freeze
Shock—20G @ 5ms, 15G @ 11ms, 10G @ 25ms
Vibration—15-min cycle 10-3000cy @ .01" dbl ampl p-p, .025" 5-min, 15-min ea plane with 30-sec cycle

8¼" (20.8cm) H x 17¾" (45cm) W x 23" (58.5cm) D with cover, 27# net, 37# shipping

Main Frame Type 765MH **$985.00**
Type 765M with 5kv option **$895.00**
Type 765 MH/F with (Y Axis Termination option) **$1060.00**
Mod 101 ..... **$195.00** additional

TYPE 777 DUAL BEAM SCOPE

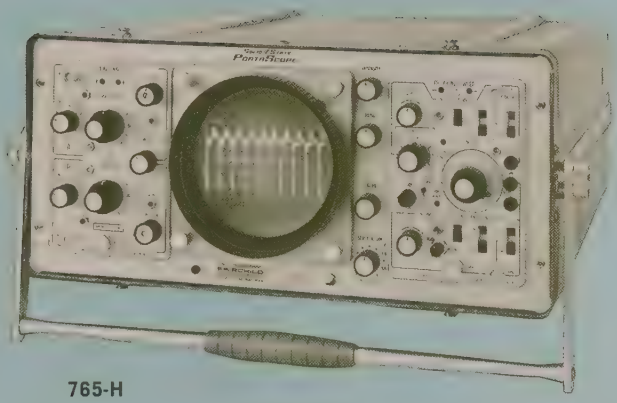
2 independent beams ■ 2 independent deflection systems ■ 13kv accelerating ■ 44 pounds ■ DC to 100 mc ■ 6 x 10 cm display each beam ■ use in 14" rack ■ solid state circuitry ■ high frequency ■ use all 74-00 and 76-00 plug-ins ■ no intermediate stages with all signal circuits in plug-ins ■ panel area for special systems controls

Display—13kv dual gun CRT 5" flat face metallized, 2 independent gun structures; Faraday shield for min spot size and defocus; P31 phosphor (P2,7,11 optional); 6 x 10cm each beam, 5cm overlap, adjustable edge lighted graticule; 2 CRT grids accessible @ rear
Temperature— −40° to +85°C stored; 0° to 50°C operate
Altitude—10,000′ operate, 50,000′ non-operate
Humidity—Constant operation at 95% relative humidity and 40°C
Shock—10G for 25ms
Power—115/230v, 350w, 48-62cps, 48-450 cps with mod 101

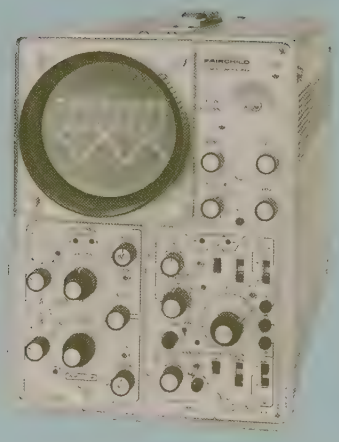
13⅞" (35cm) H x 16⅜" (41.3cm) W x 21" (53.3cm) D, 44# net, 64# shipping
Main Frame Type 777 ..... **$1,600.00**

FAIRCHILD

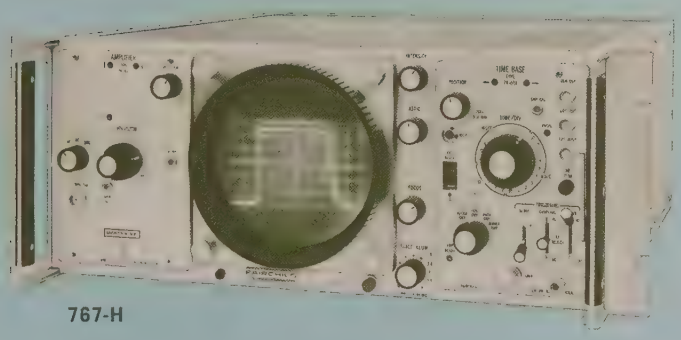
Types
765H
766H
767H
757
765MH
777



765-H



766-H



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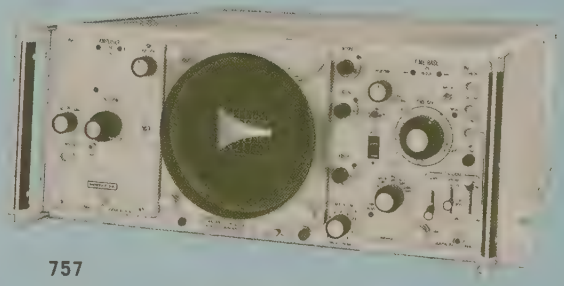

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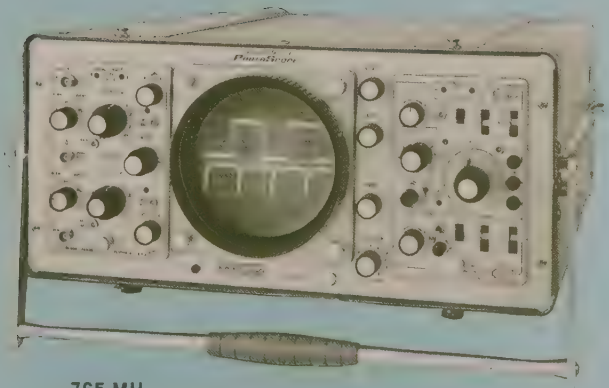

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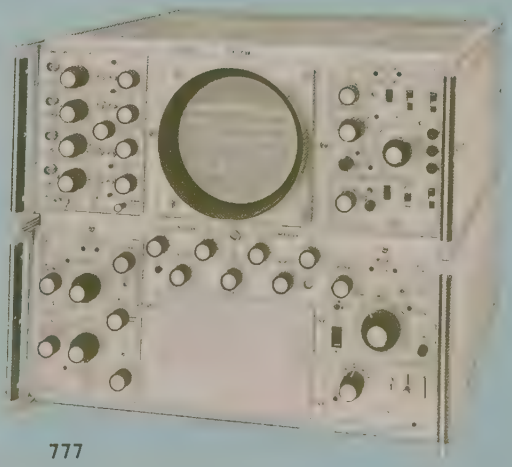
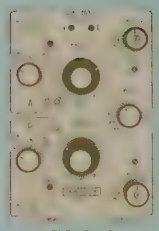


777

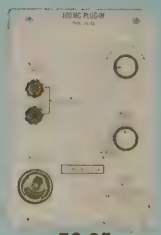
FAIRCHILD

PLUG-INS 765 SERIES

76-01A


76-02A

76-03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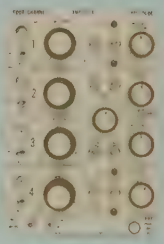
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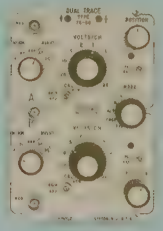
76-07

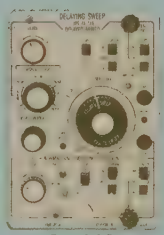

76-08

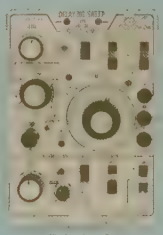
74-12

74-15

74-19

74-03A


74-11A


74-13A

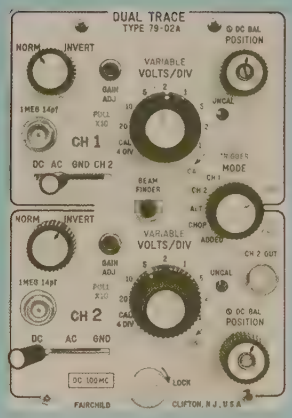
74-14

Plug-Ins, 765 SERIES

Type	Description	Vertical Band Pass	Risetime	Sensitivity	Signal Delay	Scan	Price
76-01A	Single Trace	DC-25mc	14.5ns	5mv-10v/div	(230ns) option	6 div	$385.00 $460.00 with signal delay
76-02A	Dual Trace A,B,Alt, Chop, A±B	DC-25mc	14.5ns	5mv-10v/div	(230ns) option	6 div	$475.00 $550.00 with signal delay
76-03	Single Trace	DC-50mc	7.5ns	50mv-20v/div	230ns	6 div	$450.00
76-05	100mc	DC-100mc	3.5ns	5v-7.5v/div	150ns	6 div	$225.00
76-06	4 Trace 1,2,3,4, 1&4, 2&3, 123&4, 1±2 & 3±4, 3±4	DC-20mc	17.5ns	20mv-10v/div	(230ns) option	6 div	$695.00 $770.00 with signal delay
76-07	Differential Comparator A,-B,A-B, A-Vc, Vc-B	DC-15mc	24ns	5mv-2v/div	(230ns) option	6 div	$695.00 $770.00 with signal delay
76-08	Dual Trace A,B,Chop,Alt, A±B,2preamps cascaded	DC-50mc DC-25mc	7.5ns 14.5ns	50mv-20v/div 5mv-2v/div	230ns	6 div	$650.00
74-12	Differential Amplifier A,-B,A-B	DC-850kc	0.41μs	1mv-10v/div (500μv/div Y sensitivity)	no delay	6 div vert 10 div horiz	$169.50
74-15	Single Trace	DC-1mc	0.35μs	20mv-20v/div (10mv Y sens)	no delay	6 div vert 10 div horiz	$105.00
74-19	Single Trace	DC-5mc	.07μs	50mv/div	no delay	6 div	$175.00

Type	Description	Sweep Rate	Magnifier	Sweep Delay Range	Trigger Sensitivity @ 100kc		Horizontal Amplifier		Price
					Internal	External	Bandwidth	Sensitivity	
74-03A	Time Base Generator (5ns/div)	50ns-2sec/div	X10	none	2mm	250mv	DC-4mc	100mv-10v/div	$395.00
74-11A	Dual Time Base Delaying Sweep	100ns-2sec/div	X10	.5μs-20sec	3mm	500mv	DC-2mc	200mv-20v/div	$675.00
74-13A	Dual Time Base Calibrated Delaying Sweep	100ns-2sec/div	X10	.25μs-20sec	3mm	500mv	DC-2mc	200mv-20v/div	$750.00
74-14	Time Base Generator (100ns/div)	1μs-2sec/div	X10	none	5mm @ 350kc	500mv @ 350kc	DC-350kc	100mv-10v/div	$210.00

TYPE 79-02A 100MC DUAL TRACE AMPLIFIER PLUG-IN



doubles the performance of all other solid state units ■ gives widest bandwidth dual trace available ■ 3.5ns risetime ■ 10mv/cm sensitivity (X10 amplifier) ■ 1 mc or 100 kc chop rate ■ solid state circuitry ■ beam finder ■ dual trace (10mv/cm) 100mc amplifier ■ with inputs cascaded, single trace 1mv/cm at 50mc

Sensitivity—X1 Amplifier—100mv/div to 20volts/div in 8 calibrated steps of 1,2,5 sequence, variable gain control gives 2½ to 1 continuous sensitivity adjustment

X10 Amplifier—10mv/div to 2volts/div in 8 calibrated steps of 1,2,5 sequence; variable gain control provides continuous sensitivity adjustment from 2volts/div to 5volts/division

Risetime—3.5ns with X10 Amplifier, 3.9 ns

Bandwidth—X1 DC - 100mc, down 3db, X10 DC - 90mc, down 3db.

Modes of Operation—
Ch. 1 only, Ch. 2 only, Chop (sampled at 1mc or 100kc rate), Alternate (switched on alternate sweeps), Algebraically added

Chop Rate Selection—Select rates of 1mc or 100kc with the internal selector switch.

Input Coupling—Either AC or DC coupling of the input signal is provided each channel by lever switch; off position on the input coupling switch provides ground reference or base line.

Input Impedance—1 megohm paralleled by 14pf. With Type 7990 X10 Attenuator Probe, 10 megohms paralleled by 7pf.

Signal Delay—230ns delay is built in. Delay is sufficient for view of base line and the leading edge of a fast risetime pulse.

Internal Trigger Mode—The two-position switch provides selection of trigger from composite signal or Channel 2 only.

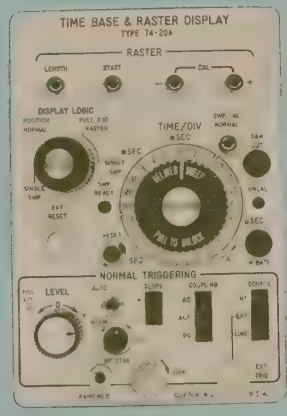
Cascaded Amplifiers—Two preamplifiers cascaded give a high gain single trace unit 1mv/div; 50mc bandpass with front panel switch.

Channel 2 Output—Front panel jack access, 5k output imp.

Modification for Standard Main Frame Indicators—Modification Kit, with new CRT and termination, gives vertical standardization of 765H and 757 Series Main Frames, for optimum results with the 79-02A (and all 76-00 series) plug-ins. Main Frame Modification Kit **$235.00.**

Type 79-02A 100mc Dual Trace Amplifier **$1200.00**

TYPE 74-20A TIME BASE & RASTER DISPLAY PLUG-IN



resolves time display to 1 part in 5000 ■ single shot or repetitive displays ■ 1μs time per raster line ■ raster sweep linearity 1% ■ raster display or conventional sweep time base ■ use with dual trace signal amplifier plug-ins ■ local or remote rearm

Raster Display—Time/line 1μs to 20sec in 23 1,2,5 steps; 3% accurate; Time/frame 1 MS to 20sec in 23 1,2,5 steps; 2½:1 continuous change variable control; 12sec slowest; 1% sweep linearity in X1, 3% in X10; 1 to 100+ lines/frame; turnaround nominally 75ns; rearm for single frame with push button or front panel connector

Conventional Sweep—100ns/div to 2sec/div; 23 steps 1,2,5; 1% nominal accuracy; 2½:1 variable sweep; X10 magnifier expands sweep rate to 10ns/div

Output Signals—8volts into 10k gateout; 8volts into 10k sawout for time/frame.

Triggering—selects signals from internal, external, or line sources, + or — slopes, DC or AC coupled; low freq reject position for sync signals over 10kc or risetimes faster than 100μs

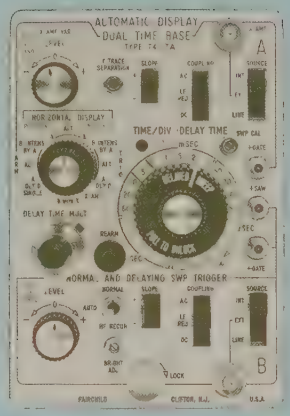
Type 74-20A Time Base & Raster Display (with 7082 connecting cable) **$985.00**

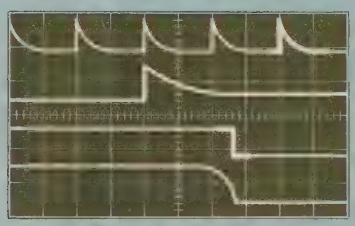
ACCESSORIES

TYPE	DESCRIPTION	PRICE
4285A	Termination, 50 ohm, BNC Connectors	$16.50
7093	5:1 Attenuator Pad, 50 ohms BNC to BNC	16.50
4287	UG-306A/U BNC 90° Elbow	3.50
7081	BNC T-Connector (UG-274/U)	3.50
7082	BNC to BNC Jumper Cable (42")	4.75
7994	Attenuator Probe X10 (4" cable) with high frequency compensation	40.00

FAIRCHILD

New Plug-ins 765 Series





TYPE 74-17A AUTOMATIC BEAM SWITCHING & DELAYING SWEEP PLUG-IN

2 independent sweeps (beam switching) ■ full bandpass triggering ■ solid state circuitry ■ internal precision delay ■ 5ns/div sweep rate ■ delaying sweep generator or two independent sweeps ■ alternate presentations of A signal at 2 different speeds ■ dual trace ■ automatic beam switching between normal sweep & X-Y displays

Sweep Range—Both sweeps have calibrated range from 50ns/div to 2sec/div in 24 steps of 1,2,5 sequence; nominal accuracy 1%; variable control continuous 2½:1

X10 Magnifier—increases sweep rate of both delaying & delayed sweeps to 5ns/div

Normal, A or B Sweep—Conventional time base display

Automatic Dual Scope Display—Both A & B shown; electronic switch alternates sweeps A & B

Triggered or Armed Mode—Sweep B intensified by A, Sweep B display shows A as brightened sector, A starts immediately after delay pickoff trigger generated; Sweep A delayed; Alternate Display, Sweep B intensified by A, and A delayed by B

X Amplifier—For X-Y displays

Alternate, X-Amp & Sweep B—X-Amp & B displayed alternately

Time Delay—Sweep A can be continuously delayed from 1/4μs to 20sec with nominal accuracy ±1%, delay time incremental linearity within ±0.25%

Trigger Capabilities—Both sweep generators have identical independent trigger circuits, auto & high frequency sync in B sweep trigger circuit

Trigger Selection—select signals from internal, external or line sources, plus or minus slopes, DC or AC coupled; low frequency reject position for sync signals over 10kc or rise-time faster than 100μs

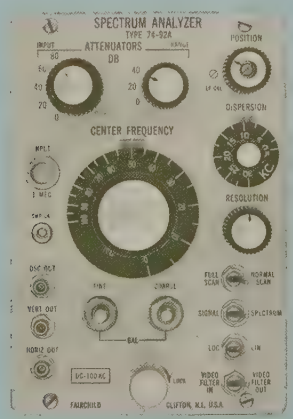
Trigger Level—±15volts, X10 range extends external trigger level to ±150volts

Auto Sync—Special circuit provides bright base line display in the absence of trigger signal

Horizontal Amplifier—Nominal sensitivity 0.02volts/div (X10 expand), bandwidth 2.5mc, amplifier available through Sweep A external trigger input connector when in X amplifier mode, position indicator lights show beam direction when off screen

Type 74-17A Beam Switching & Delaying Sweep **$1225.00**

	74-91A	74-92A	74-93A	74-94A
Center Frequency Range	10cps to 20kc	35cps to 100kc	150cps to 500kc	1kc-2mc
Calibrated Tuning Dial Range	0 to 20kc	0 to 100kc	0 to 500kc	0-2mc
Dispersion (sweep width) Continuously Variable	100cps to 6kc	500cps to 30kc	2.5kc to 150kc	10kc-600kc
Resolution Bandwidth (continuously variable)	10cps to 100cps	35cps to 250cps	150cps to 2kc	1kc-8kc
IF Frequency	100kc	262kc	1.5mc	10.7mc
Oscillator Frequency	120kc to 100kc	362kc to 262kc	2mc to 1.5mc	12.7 to 16.7mc
Price	$820	$820	$820	$950



74-90 SERIES

SPECTRUM ANALYZER PLUG-INS

74-91A (DC TO 20 KC), 74-92A (DC TO 100 KC), 74-93A (DC TO 500 KC) 74-94A (1KC TO 2 MC)

manual sweep ■ exceptional accuracy ■ fit all Fairchild solid state scopes ■ incidental FM less than 1% ■ vertical & horizontal output for X-Y recorder ■ use for telemetry subcarrier oscillator analysis ■ measure vibration, noise & distortion ■ harmonic & intermodulation distortion ■ sonar & subcarrier analysis ■ spectral & energy distribution ■ power level measurements ■ manual sweep for frequency determination to accuracy limited only by external counter

Modes of Operation—Normal, tuning dial determines center frequency; Full Scan, entire band displayed; Manual, DC voltage to sweep oscillator & position beam

Tuning Dial & Dispersion Accuracy—±10%

Display—input voltage amplitude scales linear or 40db logarithmic

Sensitivity—45μvolts/div maximum sensitivity

Noise Level—less than 10μvolts referred to input

Amplitude Scale Accuracy—linear ±10%, ±1db

Amplitude Response Flatness—±1db

Sweep Rate—determined by time/cm switch setting

Input Attenuator—80db max, 20db steps

Input Impedance—1 megohm shunted by 50pf

Dynamic Range—harmonic and IM products 60db down

Incidental FM—less than 1% narrowest resolution bandwidth

IF Attenuator—40db max, 20db steps

IF Gain Control—20db continuously variable

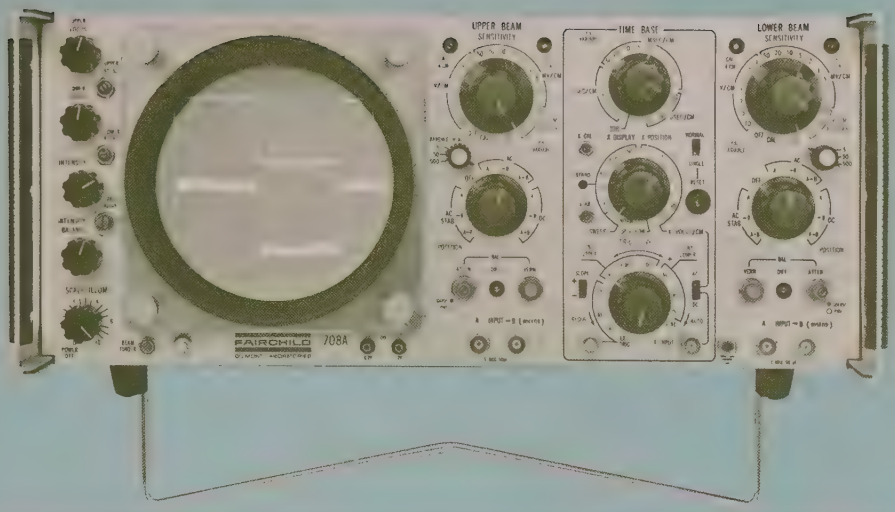
Oscillator Output—1volt p-p min from 4.7k ohms

Video Filter (low pass)—50ms, selectable front panel switch

Vertical Output—minus .5v/cm from 47k, DC coupled

Horizontal Output—1volt peak neg from 10k ohms coupled

New
708A
FAIRCHILD



TYPE 708A HIGH GAIN DUAL BEAM OSCILLOSCOPE

no time sharing ■ dual gun CRT ■ two identical vertical amplifiers ■ 10μv/cm sensitivity ■ selectable bandpass ■ stabilized amplifiers ■ 6 x 10 cm viewing area each beam ■ 5kv aluminized high intensity CRT ■ universal bench & 7" rack mount ■ simple panel controls ■ unique electrometer type input stage ■ exceptional stability ■ wide range sweep (0.1μs/cm to 1 minute full scale) ■ transistorized amplifiers ■ indicator for transducers ■ electromedical research ■ servo work ■ general purpose ■ dual beam display without time sharing

UPPER & LOWER BEAM VERTICAL AMPLIFIERS

Sensitivity—10μv to 10volts/cm in 19 steps of 1,2,5 sequence ■ pull variable control for 2½:1 continuous variation 10μv/cm to 25volts/cm; amplifier attenuators compensated for probes; differential input operation on all ranges. For sensitivities greater than 100mv/cm the unit is AC coupled. Lower 3db frequency 5 cps.

Bandwidth—DC to 500kc (down 3db) selectable in 3 switch steps, DC to 5kc, DC to 50kc, DC to 500kc; AC coupled, low frequency 3db point is 5cps

Modes of Operation—front panel switch selects modes for each beam, Input A only, Input —B only, Differential input

Attenuator Accuracy—within 3%

Common Mode Rejection—5000:1 (72db) from 0.2mv/cm, common mode signal not to exceed 6volts p-p or ±3 volts DC; at least 20db all other ranges

Differential Input—All attenuator ranges of upper & lower beam amplifiers

Phase Shift—between orthogonal (X-Y) system adjustable to within ±1° at any point from DC to 100kc at calibrated gain; adjusted to 0° phase shift at 100kc, differential is ±2° from DC to 150kc

Input Coupling—DC or AC; AC coupled, low frequency 3db point 5cps; input signals of 600volts p-p AC or DC; AC stabilized for low input signals

Input Impedance—Single Ended, 1 megohm paralleled by 50pf; Differential, 2 megohms paralleled by less than 40pf

X-Y Plotting—Front panel switch provides lower vertical amplifier plotted against upper vertical amplifier.

TIME BASE

Sweep Range—Calibrated from 5μs to 2sec/cm in 18 steps of 1,2,5 sequence; accuracy always better than 3%; variable control extends slowest sweep to 6sec/cm (1 minute full scale); expander extends fastest rate to 100ns/cm

Expander—6 step expander for sweep expansion of X1, X2, X5, X10, X20, X50; with X50 magnifier sweep rate 100ns/cm; expansion accuracy 5% for sweep rates to 1μs/cm, 10% for faster sweep rates

Triggering Capabilities—trigger from internal either beam, external & line sources on either positive or negative slopes

Trigger Sensitivity—Internal, signals synchronized from 4mm vertical deflection driven sweep; when in auto sync less than 3mm required for trigger DC to 500kc; internal trigger DC coupling gives triggered reference to CRT scale

External, trigger from DC to 500kc at signal level of 500mv p-p; 400mv p-p required in auto trigger

Auto Trigger—sweep will free run at 50cps rate in absence of sync signal

Trigger Level—±10volts on external, ±1.5volts full scale on internal

Single Sweep—push button rearming switch and rearm indicator light on front panel; remote electrical rearming available thru BNC on rear

HORIZONTAL AMPLIFIER

Sensitivity—20mv to 1volt/cm in 6 steps of 1,2,5 sequence; pull variable control (uncalibrated) permits 3:1 adjustment for continuous variation between 20mv/cm and 3volts/cm

Bandwidth—DC to 1mc, down 3db; AC coupled, low frequency 3db point 5cps

Risetime—.35μs

Calibration Accuracy—built-in 5cm calibration signal for easy calibration; accuracy within 3% any one setting on volts/cm switch

Input Impedance—1 megohm paralleled by 50pf; with X10 probe (Type 4290) 10 megohms paralleled by 13pf

DISPLAY

Cathode-Ray Tube—flat faced 5inch dual gun tight tolerance CRT; aluminized post-accelerator tube has 5kv accelerating potential, high brightness, good contrast and beam gating, automatic screen burn protection; P31 phosphor usually supplied; P7, P11 phosphors available; two completely independent electron guns have independent vertical deflection plates and common horizontal deflection plates

Accelerating Potential—5kv

CRT Scale—6 x 10cm each gun; illuminated graticule, 5cm overlap

Beam Finder—push-button beam finder

Z-Axis—negative pulse of 25volts required to blank trace; AC coupled to grid of CRT, 1 megohm through series 0.01μf capacitor; available through BNC at rear

GENERAL

Calibrator—line frequency, internal 5cm cal, external .2v and 2v for probe compensation

Power Requirements—115 or 230volt line, 200watts, 48-450cps

Temperature Range—Storage, —40°C to 85°C; Operating, 0°C to 50°C (no vent fan required)

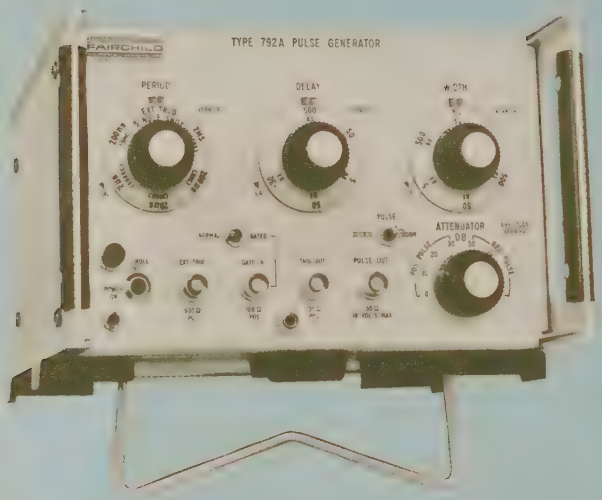
Vibration & Shock—National Safe Transit Test

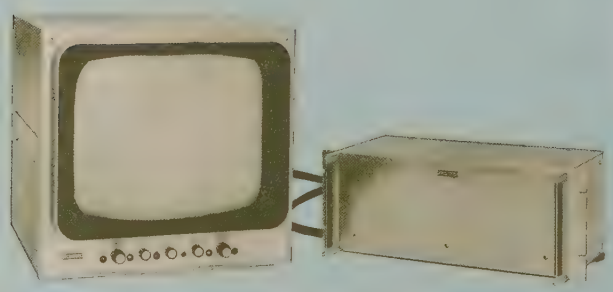
Bench (tilt stand supplied) 7⅝" (19.3cm) H x 16¾" (42.5cm) W x 21" (53.3cm) D; Rack (use optional Type 7086 mounting ears) 6-31/32" (17.7cm) H x 16¾" (42.5cm) W x 17½" (44.5cm) D; 35# net, 40# shipping

Type 708A Dual Beam Scope **$995.00**

FAIRCHILD

New Type 792 Type 737





TYPE 792A DOUBLE OR SINGLE PULSE GENERATOR

10mc pulse repetition rate ■ gated operation ■ constant amplitude ■ ±10volts into 50ohms ■ light weight ■ rugged ■ solid state

Amplitude—10volts into 50ohms, 17volts into 1000ohms

Risetime—8ns or less

Fall Time—8ns or less

Polarity—positive or negative

Pulse Droop—Negligible all ranges

Undershoot & Overshoot—5% or less at maximum amplitude

Repetition Rate—50cps to 5mc, double pulse to 10mc

External Trigger In—AC coupled, 3volts minimum (positive, Z_{in}=600ohms); Any rate up to 5mc

Single Pulse—Single shot available with front panel push button switch; double or single pulse for every trigger pulse (change pulse switch to double pulse)

Pulse Delay—Continuously variable from 30ns before to 5ms after trigger output pulse

Width—50ns to 5ms

Duty Factor—30% can be increased to 70% at reduced amplitude

Trigger Out—4volts minimum (positive, 50ns wide into 1k ohms); 2volts minimum (50ns wide into 100ohms)

Gated Operation—AC coupled, Z_{in} =10k ohms, 10volts minimum; Positive response time = 80ns at minimum delay, 15volts minimum at 50% duty cycle on Gate; maximum gate width 10ms at 10% duty cycle and 15volts

Power—115/230v, 50-450cps

Mounting—Universal half rack configuration

Type 792A Double or Single Pulse Generator **$520.00**
(includes power cord, 4285A termination, 2 each 7082 cables)

TYPE 737A LARGE SCREEN ELECTROSTATIC X-Y INDICATOR

1mc large screen indicator ■ 17" electrostatic rectangular CRT ■ 88 square inch quality rectangle ■ full bandwidth X, Y & Z axes ■ DC coupling all axes ■ 10kv overall accelerating potential ■ high linearity ■ uniform spot size ■ bench or rack mount

Bandwidth (X & Y)—DC Coupled, DC to 1mc down 3db measured at full screen

Risetime, 0.35μsec maximum measured 10% to 90% with less than 2% overshoot

Sensitivity (X & Y)—1 volt full screen, continuously variable to 5v full screen

Input Impedance—1 megohm shunted by 40pf ±10%; BNC connectors at rear of indicator

Common Mode—±25volts offset potential, 30db minimum common mode rejection DC to 1kc, 20db to 10kc

Deflection Linearity—±2% maximum overall within quality rectangle; ±10% maximum, 1-division increments

Phase Shift—Phase shift between orthogonal systems ±0.1 degree maximum at 1kc and ±1degree maximum at 100kc; internal adjustment provided

Stability—Less than ½cm drift per hour at maximum sensitivity (controlled ambient and line voltage conditions)

Positioning Range—Minimum of full screen

Z Axis—DC coupled, 5v signal will blank or intensify normal trace

Cathode-Ray Tube—With P31 phosphor normally supplied; P7, optional phosphor; 8 x 10 or 10 x 10 div internal graticules optional at additional cost

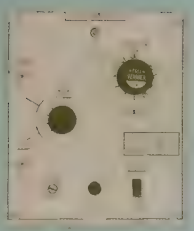
Accelerating Voltage—10kv

Display Area—Quality rectangle 21cm x 28cm minimum, overall scan 25 x 31cm

AC Power—115/230v, 50/60cps, 750w (50-400 operation optional)

Mechanical Dimensions—universal bench or rack use (rack mount adapter plates included); Indicator Unit 15¾" maximum H x 16¾" max W x 18¾" max D (17" behind rack mounting surface, CRT housing extends 5¾" behind rear panel) approx 65#; Power Supply 7" max H x 16¾" max W x 11" max D (includes connectors) interconnecting cable 5' approx 48#

Type 737 Large Screen X-Y Indicator **$3450.00**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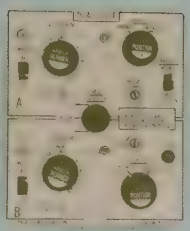
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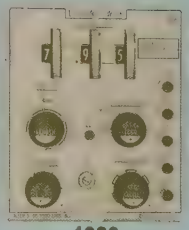
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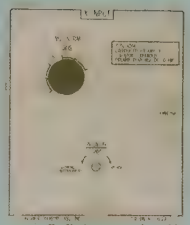
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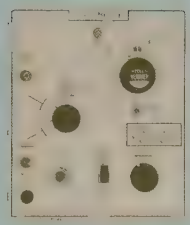
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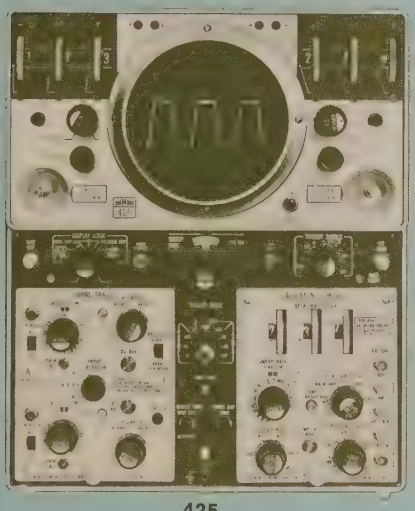
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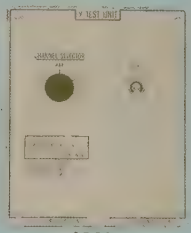
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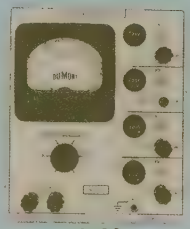
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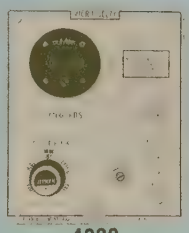
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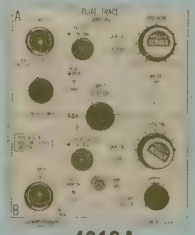
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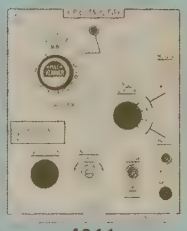
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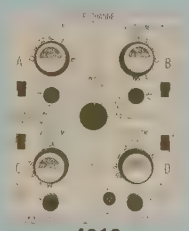

4212

TYPE 425 DIGITAL READOUT GENERAL PURPOSE SCOPE

measurement accuracy ■ modular construction ■ wide selection X & Y plug-ins ■ any lab or production application ■ 2 dots superimposed on waveforms ■ joystick controls ■ use as a-d converter ■ attach punch card or any print-out device ■ direct digital readout 2 axes

Frequency Range—DC-35mc; 1 kmc with sampling plug-ins
Risetime—Y-10ns; X-90ns; to .35ns with sampling plug-ins
Sweep Rate—Fastest 10ns/cm (to .1ns/cm with sampling plug-ins); slowest 6 sec/cm
Display—5 x 10 cm 12kv CRT

13½" (34.3cm) W x 27" (68.5cm) D x 16½" (41.9cm) H, 125# — Main Frame **$2,975.00**

TYPE 4201
Description— Y-Preamplifier Single Channel
Sensitivity— 50mv/cm to 20v/cm
Bandpass— DC to 35 mc
Price— **$195.00**

TYPE 4202
Description— Dual Trace Y Preamplifier
Sensitivity— 50mv/cm
Bandpass— DC to 33 mc both traces
Price— **$295.00**

TYPE 4203
Description— Delaying Sweep
Sensitivity— 25ns to 10sec
Time Base— continuous variable, .5% precision, less than 1/20,000 jitter
Price— **$495.00**

TYPE 4204
Description— X Input
Sensitivity— 2v/cm to 10v/cm
Bandpass— DC to 4 mc
Price— **$125.00**

TYPE 4205
Description— Y Preamplifier
Sensitivity— 5mv/cm to 2v/cm
Bandpass— DC to 21 mc
Price— **$275.00**

TYPE 4207
Description— Y Test Unit provides test signals; vertical amplifier alignment and recalibration
Price— **$140.00**

TYPE 4208
Description— Power Access for Systems use in lab 5 regulated outputs +420v to −150v
Price— **$75.00**

TYPE 4209
Description— Micro Delay for precise incremental t_r and delay measurement
Delay— 0-100ns, .1ns resolution trigger delay
Price— **$295.00**

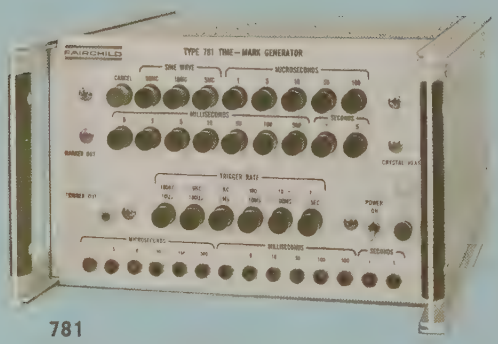
TYPE 4210 A/B
Description— Sampling plug-in
Sensitivity— 5mv/cm
Bandpass & Time Base— DC-1000mc bw, .35ns t_r, 50 ohm input, .2ns/cm to 10ns/cm sweep speeds 1,2, 5 steps, 0-100ns delay
Price— **$1495.00**

TYPE 4211
Description— Sweep Expander and X Preamp for X-Y with stable wideband (2mc)
Time Base— Sweep expand to X100
Price— **$235.00**

TYPE 4212
Description— Four Trace for single, dual or 4-traces display of unrelated signals, algebraically added dual trace and dual trace with readout
Bandpass— DC to 30mc
Sensitivity— 50mv/cm to 2v/cm
Price— **$545.00**

FAIRCHILD

Types
781
791
404-B



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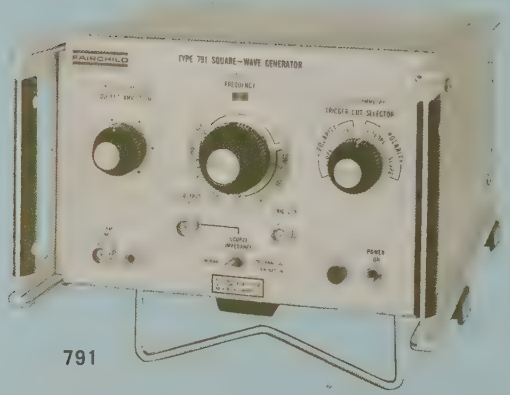

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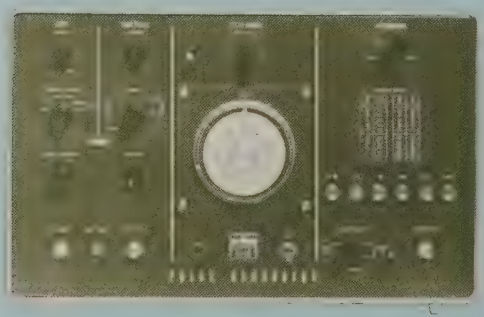

404-B

TYPE 781A TIME MARK GENERATOR

14 time mark intervals 1μs-5sec ■ 5,10,50mc sine wave outputs ■ 6 decade trigger ■ .001% accuracy ■ 3/1,000,000/day stability ■ solid state circuitry ■ MIL type circuit boards ■ plated through holes ■ low heat and power consumption

Time Markers—1,5,10,50,100,500μs; 1,5,10,100,500 ms; 1 & 5 sec; 2 simultaneous outputs, individual markers with push button selectors and BNC output jack; 25v open circuit from tip jacks; 4v open circuit from marker output jack
Sine Wave—3 outputs 5,10,50mc; button switch selectable 3v p-p output across 50 ohms
Trigger Rate Generator—1,10,100 cps 1,10,100 kc coincident with time marker
Stability & Jitter—pulses from temp stable 1mc crystal, variation of 10cps/1mc, can be beat with WWV via trimmer cap, stable to 3/1,000,000/24hrs; pulse-pulse jitter under .05% of rep rate
Power—110/220v, 21w, 48 to 450cps

5¼" (13.3cm) H x 8¼" (21cm) W x 10½" (26.6cm) D with handle, 9.5# **$620.00**

TYPE 791A SQUARE WAVE GENERATOR

7 cycle to 10 mc square wave output ■ 3ns fall time ■ 6ns risetime ■ 40v open circuit ■ 20w ■ solid state circuitry ■ wide frequency range

Square Wave Output—25cy to 10mc, 12 steps 1,2,5 sequence; less than 3ns fall time when terminated in 50 ohms; less than 6ns risetime term 50 ohms; termination selector switch for 600 or 50 ohms; output amplitude continuously variable

Source Impedance Output Voltage Range		
	Source Impedance	
Load	600 Ohm	50 Ohm
Open Circuit	3-40volts	.25-3volts
600 Ohm Output Impedance	1.5-20volts	.23-3volts
50 Ohm Output Impedance	.25-3volts	.125-1.5volts

Trigger Output—max risetime 10ns terminated @ 50 ohms; select pos or neg polarity of square wave; 5v into 50 ohms
External Sync—Square wave freq slave to ext freq max sync 1mc
Other—110/220v, 20w, 48-450 cps

5¼" (13.3cm) H x 8¼" (21cm) W x 10½" (26.6cm) D with handle, 9.5# **$420.00**

TYPE 404-B PULSE GENERATOR

50 V into 50 Ohms ■ 13ns risetime ■ variable internal delay ■ variable pulse width ■ rep rates to 250,000 pps ■ single push button actuated pulse of selected width and amplitude

Pulse—peak voltage 50v ±10% 50 ohm term, 75v ±20% 75 ohm term, 95v ±20% 95 ohm term; 13ns rise or fall time; 5% max tilt pos pulse, 15% max neg pulse; 59.5db in .5db incr atten; ±1% accurate; 50 ohms output imp direct or thru atten; 5w max pulse power; 50w max peak pulse; 1 amp max peak pulse current; .05-105μsec pulse width in 3 cal ranges; min pulse width adj to 25ns; 9-12% auto duty limit protect indicator
Trigger—rep rate under 10pps to over 250,000pps cont var int, single pulse to 250kc ext; min amplitude 4v peak, max 60v; pos or neg ext polarity; 10v amplitude term 91 ohms; advance to 2μsec or delay to 12.5ms
Power—110/220v, 60 cycle line

Bench 11⅜" (20.89cm) H x 17⅝" (44.7cm) W x 16½" (41.91 cm) D with knobs, 55#, Type 404-B **$760.00**

Rack 10¼" (26.67cm) H x 16⅞" (42.85cm) W x 15$\frac{7}{32}$" (38.65cm) D, 55#, Type 404-BR **$760.00**

ACCESSORIES

TYPE NO.	DESCRIPTION	PRICE
4285-A	50 Ohm Termination	$ 16.50
7093	5 to 1 Attenuator	16.50
7012	Capacitance Standardizer — nominal tuning range of 20 to 55 pf	12.50
7085	Detented Tilt-Slide for the 700 and 765H series	40.00
4006	Detented Tilt-Slide for the 403BR and 440R	40.00
7099	Rack Slides for 781 and 791	40.00
7086	Rack Mount Ears for the 700 series and 767H series	5.00
4273	Cradle Type Rack Mount for the 425	75.00
7087	Luggage Type Carry Handle for 700 to 704 and 767H scopes	2.00
7090	Protective Cover for front of 700 to 704 and 767H	35.00
7095	Protective Cover, 5" high panel	30.00
7091	Fitted Accessory Mounting Board for type 7090 protective cover	10.00
7097	Hardware Kit for common packaging of 781 with 791	15.00
7096	Rack Mount Ears for common 781-791 package	5.00
7098	Blank ½ Rack Panel for full rack mounting of 781 or 791	25.00
7094	Protective Panel Cover for the 781 or 791	25.00
7092	Storage Cabinet for all 765 series plug-ins	38.50
2592-B	Terminal Adaptor, binding post to female BNC	10.00
4283	Terminal Adaptor, "GR" to BNC male	7.50
4288	Terminal Adaptor, UHF female to male BNC	3.50
4287	UG #306A/U 90° BNC elbow	3.50
7080	Terminal Adaptor, BNC to binding post UG #1090/U	2.35
7081	UG #274/U BNC "T" Connector	3.50
7084	Terminal Adaptor, male "C" to female BNC, UG #636/U	3.50
7082	Cable, male BNC to male BNC, 42" length of 50 ohm coax	4.75
7083	Cable, male BNC to insulated alligator spring clips, 42" long	3.85
7030	Scope Traveler (size of top tray 17¾" x 22½")	75.00
7031	Scope Traveler Drawer (top tray 17¾" wide)	34.50
7020	Scope Traveler (size of top tray 10¾" x 22½")	65.00
7021	Scope Traveler Accessory Drawer only	30.00
7022	Scope Traveler Accessory Drawer and Plug-In Carrier, UL approved AC Outlet	34.50
4270	Scope Traveler (tray size 16" x 27") capacity 500 pounds	85.00
7010	2000 Hours Maintenance Kit	250.00
7011	2500 Hours Maintenance Kit with 5 kv CRT	395.00
7011-H	2500 Hours Maintenance Kit with 13 kv CRT	450.00
4294	Plug-in Extension Cable (25" long extension cable for plug-ins in the 425 and 765H series scopes)	35.00
7013	Tool Kit for 765H series maintenance	9.50
4295	Tool Kit for 425 oscilloscope recalibration	65.00
4296-A	Operational Accessory Kit for 425 and 765 series	95.00
4002-B	General Accessory Kit — low frequency	95.00
7035	Viewing Hood — round light shield	4.95
276-C	Viewing Hood, molded rubber	14.00
4005	Tilt Stand and Line Cord Reel Kit for 403B, 436 and 440 oscilloscopes (factory installed $10.00 additional)	4.75
7651-A	Self-Storing Plastic Insert, complete with accessories for 765 Porta-Scope	185.00
74-00	Blank Plug-In Chassis for 765H series	35.00
7001	Delay Line (230 nanoseconds) for 765H series plug-ins	75.00
7002	Delay Line for 76-06 plug-in	75.00
4561	Bezel for Tektronix rectangular type CRT oscilloscopes	14.50
4551	Bezel for Tektronix round type CRT oscilloscopes	4.50
7079	Rear Access Connectors for 767H and 757 rack mounted oscilloscopes	30.00
7089	Rear Access Connectors for 700, 701, 702, 704 oscilloscopes	12.50
7088	Z Axis Modulation for 700, 701, 702 or 704 scopes (factory installation $3.00 additional)	8.75
4279	DC Fan Motor Mod Kit (400 CPS operation) for 425 oscilloscope Factory installed before shipment	100.00 75.00

GENERAL PURPOSE PROBES

Probe Type	Resistance	Input Capacitance	Attenuation Ratio	Cable Length	Price
4289	1 meg	59-91 pf	1:1	4 ft	$30.00
4290	10	10-13	10:1	4	30.00
4290-A	10	10-13	10:1	4	30.00
4298	10	14-17	10:1	8	32.50
4298-A	10	14-17	10:1	8	32.50
4299	10	12-15	10:1	6	32.50
4299-A	10	12-15	10:1	6	32.50
4292	10	1.7-2.5	100:1	4	32.50

PLEXIGLASS FILTERS FOR 700, 701, 702, 704, 765H SERIES

Type	Part Number	Phosphor Type	Price
Blue	4800 4512 4800 5862	P11 P7	$1.25 1.25
Green	4800 4511 4800 5863	P1 P2 - P31	1.25 1.25
Amber	4800 5861	P7	1.25
Polaroid Plexiglass scale	4800 6101		2.50

INTERNAL GRATICULE CRT'S

For Scope Type	Type No.	Factory Installed	Field Kit
700, 701, 702, 704	7042	$15.00 additional	$ 75.00
765 Series, 5 kv	7060	35.00	110.00
765H Series, 13 kv	7061	35.00	175.00

FAIRCHILD

Types
302-B
321-A
450-A
453 /
453-A

302-B

321-A

450-A

453

TYPE 302-B
POLAROID CAMERA FOR 5" SCOPE

record on Polaroid Film Pack 3¼" x 4¼" and 4" x 5" with Graflok back ■ or conventional 2¼" x 3¼" roll film ■ mount on any 5" scope ■ simultaneous recording of data and viewing of trace ■ direct no-parallax viewing of screen ■ slide back along focal plane ■ expose more than one trace per frame ■ detent mechanism positions back for 9 equally spaced exposures ■ observe data card and trace through dichroic mirror while recording

Order Model No.	Lens-Shutter Assembly Description	Price
302-B	f/1.9 lens—Wollensak 75mm, 1:0.45 Fixed Object-to-Image Ratio	$435.00

Specifications

Lens	Optical System	Object-to-Image Ratio	Aperture Settings	Shutter Speeds
f/1.9 75mm	Wollensak No. 3 Alphax heavy duty shutter	1:0.45 fixed	f/1.9, f/2.8, f/4, f/5.6, f/8, f/11, f/16	1/100 to 1 sec., time and bulb

RECORDING MATERIALS: Polaroid 107 eight-exposure 3¼" x 4¼" film pack for type 4520-B; Polaroid types 55 P/N 52, 57, 510—410 Polascope 3¼" x 4¼" 4" x 5" film packet; Polaroid types 42, 44, 46L, 47, and roll films (for cameras which still use Polaroid film adapter type 4520-A; 4" x 5" regular sheet film; and 2¼" x 3¼" standard 120 roll film.

TYPE 321-A
35mm CONTINUOUS MOTION RECORDING CAMERA

18 controlled film speeds ■ friction film drive ■ built-in timing lamp ■ continuous motion and manual single frame recording ■ from any 5" oscilloscope ■ friction transport drive coupled to 1800 rpm sync motor ■ 16 speeds from .8-3600"/minute for up to 400' ■ speeds of 5400 and 10,800"/minute for lengths to 100' ■ use perforated or unperforated film ■ use economy recording paper ■ stop film in 6" @ highest speed ■ shuttered binocular port for viewing screen while recording ■ for short term long interval time use

Order Model No.	Lens-Shutter Assembly Description	Price
321-A-1 (60 cps)	f/1.5 lens — Oscillo-Raptar 51mm, 1:0.22 Object-to-Image Ratio	$1650.00
321-A-2 (50 cps)	f/1.5 lens — Oscillo-Raptar 51mm, 1:0.22 Object-to-Image Ratio	1725.00

Specifications

Type No.	Lens	Optical System	Object-to-Image Ratio	Shutter	Film Speeds
321-A-1 & 2 (includes lens, tripod, housing, 2 mags.)	f/1.5 51mm	Wollensak Oscillo-Raptar (flat field) lens, factory-focused to image a plane 3/16 inch beyond viewing housing.	1:0.22 fixed	Capping type; actuated by drive solenoid	Variable in steps of: 0.8, 1.6, 2.5, 4.9, 7.4, 14.8, 22.2, 44.4, 66.6, 133.3, 200, 400, 600, 1200, 1800 and 3600 in/min. Also — 5400 and 10,800 in/min. with film strips up to 100 feet in length

RECORDING MATERIALS: Perforated or unperforated 35mm film in lengths up to 400 feet on cores and 100 feet daylight loading spools.

SERIES 450-A

■ Complete versatility ■ Swing Away viewing ■ Interchangeable sliding backs ■ Precision rack and pinion focusing ■ Continuously adjustable object-to-image ratio ■ Data recording facility ■ Synchro shutters ■ Interchangeable lenses (Bayonet Mount) ■ Jam proof shutters ■ Remote operation capability (electrical)

Order Model No.	Lens-Shutter Assembly Description	Lens Type Supplied	Film Holder No. Supplied	Housing No. Supplied	Price
450-A-1	f/1.9 lens—Oscillo-Raptar 75mm, 1:1 thru 1:0.85 Object-to-Image Ratio	4511	4520-B 4563	4500-A	$495.00
450-A-2	f/1.9 lens—Oscillo-Raptar 63mm, 1:0.5 thru 1:0.45 Object-to-Image Ratio	4512	4520B 4563	4500-A	495.00
450-A-3	f/1.9 lens—Oscillo-Raptar 75mm, 1:1 thru 1:0.85 Object-to-Image Ratio	4511	4515	4500-A	500.00
450-A-4	f/1.9 lens—Oscillo-Raptar 63mm, 1:0.5 thru 1:0.45 Object-to-Image Ratio	4512	4515	4500-A	500.00
*450-A-5	f/1.5 lens—Oscillo-Raptar 51mm, 1:0.22 fixed Object-to-Image Ratio	f/1.5 51mm	4530A	4500-A	650.00
*450-A-6	f/1.5 lens—Oscillo-Raptar 51mm, 1:0.22 fixed Object-to-Image Ratio and Built-in Data	f/1.5 51mm	4560	4500-A	1060.00

*35mm Single Frame Automatic Advance Recordings

TYPE 450-A MOD 102
HIGH WRITING CAMERA

■ Highest photographic writing ■ High speed/resolution - low distortion optical system ■ Features of 450-A as described above

Order Model No.	Lens & Shutter Assembly Description	Film Holder No. Supplied	Price
450A Mod 102	Swing-Away housing with f/1.5 - 51mm lens - Manual & Electric remote shutter	4566	$985.00

SERIES 453/ 453-A

■ Complete versatility ■ 453A (with "Swing-Away") ■ 453 (without "Swing-Away") ■ Interchangeable sliding backs (35mm to 4" to 5") ■ Continuous "Quick Set" focusing range ■ Continuously adjustable object-to-image ratio with one lens ■ Adjustable bezel clamp for CRT depth compensation ■ Choice of lenses (f/1.9 or f/2.8) ■ Jam-proof shutters ■ Remote operation capability (electrical)

Order Model No.	Lens-Shutter Assembly Description	Lens Type Supplied	Film Holder/ Adapter No. Supplied	Housing No. Supplied	Price
**453A-1	f/1.9 lens—Oscillo-Raptar 75mm,			4503-A	$425.00
453-1	1:1 thru 1:0.7 Object-to-Image Ratio	4533	4520B/4563	4503	390.00
**453A-2	f/2.8 lens—Amaton 75mm, 1:1 thru			4503-A	385.00
453-2	1:0.7 Object-to-Image Ratio	4553	4520B/4563	4503	350.00
***453A-3	f/1.9 lens—Oscillo-Raptar 75mm,			4503-A	430.00
453-3	1:1 thru 1:0.7 Object-to-Image Ratio	4533	4515	4503	395.00
***453A-4	f/2.8 lens—Amaton 75mm, 1:1 thru			4503-A	390.00
453-4	1:0.7 Object-to-Image Ratio	4553	4515	4503	355.00
*453A-5	f/1.5 lens—Oscillo-Raptar 51mm,			4503-A	600.00
453-5	1:0.22 fixed Object-to-Image Ratio	48004481	4530A	4503	565.00
*453A-6	f/1.5 lens—Oscillo-Raptar 51mm,			4503-A	1010.00
453-6	1:0.22 fixed Object-to-Image Ratio and Built-in Data	48004481	4560	4503	975.00

*Series 5 and 6 can be interlocked with "single shot" oscilloscope system using Type 4564 accessory.
Call Factory or nearest Field Engineer Representative for further information.
**Polaroid 3¼" x 4¼" film pack.
***Polaroid and Conventional Film 4" x 5".

CAMERA ACCESSORIES

Camera System Types				Description	Type	Price
450-A-1 thru 450-A-4	450-A-5,6	453-5,6 453-A-5,6	453-1 and 453-A-1 thru 453-4 and 453-A-4			
	X	X		Film Cassette for type 4530-A (spare)	2636	$ 5.95
	X	X		Sweep Rearming Cable Assembly for 4530-A only	2637	4.95
X	X			Basic Camera Housing (with swing-away and lift-off mount)	4500-A	200.00
		X	X	Basic Camera Housing (non-swing-away)	4503	115.00
		X	X	Basic Camera Housing (with swing-away and lift-off mount)	4503-A	150.00
X				f/1.9 Lens, Oscillo-Raptar 75mm, 1:1 thru 1:0.85 object-to-image ratio (for recording with all 450-A series except 450-A-5, 35mm)	4511	200.00
X				f/1.9 Lens, Oscillo-Raptar 63mm, 1:0.5 thru 1:0.45 object-to-image ratio (for recording with all 450-A series except 450-A-5, 35mm)	4512	200.00
X				f/4.5 Lens, Oscillo-Raptar 114mm, 1:0.34 thru 1:0.095 object-to-image ratio for field diameters 7" to 20" (for recording with all 450-A series except 450-A-5, 35mm)	4513	225.00
X				Cable Assembly, remote single sweep rearm for synchro shutter types 4511, 4512 and 4513	4514	7.50
X			X	Graflok 4 x 5 Adapter with focusing & viewing hood	4515	100.00
X			X	Graphic 120 size 8 exp Film Adapter for type 4515	4516	31.50
X			X	Polaroid 4 x 5 Film Adapter for type 4515	4517	49.95
X			X	Graphic 4 x 5 Sheet Film Holder, 2 exposures for type 4515	4519	4.95
X			X	Polaroid 3¼ x 4¼ Roll film holder with dark slide, 8 exp	4520A	95.00
X			X	Polaroid 3¼ x 4¼ Film Pack Holder with dark slide, 8 exp	4520-B	95.00
X			X	Shutter Solenoid, battery powered, minimum RFI	4521	100.00
X			X	Shutter Solenoid, 24 volts DC	4522	100.00
X			X	Shutter Solenoid, 115 volts AC (50 to 400cps)	4523-A	125.00
X	X			Data Mirror Hinged Assembly for alternate recording of data and trace	4525	35.00
X	X			Data Card and Light Source Assembly (use with 4544 or 4525)	4526	30.00
X	X	X	X	Focusing & Imaging 7x Magnifier metric scale	4529	21.00
	X	X		35mm Automatic Advance Recorder with f/1.5 - 51 mm lens, 50 exp.	4530-A	450.00
	X	X		35 mm Film Magazine, 400 exposures, 30 ft.	4531-A	305.00
		X		Spring Booster Motor provides 50 frame advance	4532	129.00
			X	f/1.9 Lens, Oscillo-Raptar 75mm, 1:1 thru 1:0.7 object-to-image ratio	4533	180.00
	X	X		Shutter Solenoid, 110 volts AC	4534-A	37.95
	X	X		Shutter Solenoid, 24 volts DC	4535-A	39.95
	X	X		Electric Booster Motor, 24 volts DC for continuous advance	4536-A	199.00
	X	X		35 mm Film Magazine, 2400 exposures, 200 ft.	4538	349.00
	X	X		Shutter Solenoid, 24 volts DC, reverse action	4539-A	42.95
X			X	Polaroid 2 minute timer	4541	5.95
X	X	X	X	Storage & Carrying Case	4542	47.50
X	X			Dichroic Data Mirror for simultaneous recording of data and trace	4544	80.00
	X	X		Focusing Adapter (ground glass) for 4530-A camera only	4547	17.95
	X	X		Spare Take-up Spool for 4531-A	4548	6.95
	X	X		Spare Supply Spool for 4531-A	4549	6.95
X	X	X	X	Bezel to adapt camera to Tektronix 5" oscilloscopes equipped with round type CRT (Tektronix Model 545-A, etc)	4551	4.50
			X	f/2.8 Lens, Amaton 75mm, 1:1 thru 1:0.7 object-to-image ratio	4553	140.00
	X	X		Pushbutton activator switch and cable for solenoid types 4534-A, 4535-A and 4539-A	4555	9.50
	X	X		*Automatic Film Advance Camera with f/1.5 Oscillo-Raptar 51mm lens and reflex recording of 7 x 7mm data adjacent to 24 x 24mm image; includes 24-hr. clock, 4-digit electric counter and 20mm x 55mm written data platen and 24-volt lighting. 36 exposures.	4560	860.00
X	X	X	X	Bezel to adapt camera to Tektronix 5" oscilloscopes equipped with rectangular type CRT (Tektronix Model 561-A, etc)	4561	14.50
X			X	Focusing Plate for 4520-B film pack holder (spare)	4563	2.50
	X	X		Automatic Recycler with two 24 vdc outputs for types 4530-A and 4560; also serves as 24 vdc accessory power supply; recycles with 7403-A time base plug-in and 4539-A solenoid	4564	245.00
				Same as type 4515, but supplied with built-in reflex data chamber with write-in platen and 3 digit manually set counter.	4566	250.00
				Techniques of Photo-Recording from Cathode-Ray Tubes Handbook (Library Edition)	67041861	4.50
				Type 107 Polaroid Film Pack, ASA 3200, 8 exposures each for 4520-B film pack holder, carton of six packs	48010360	14.00
				Type 47 Polaroid Film, ASA 3200 for 4520-B roll film adapter, carton of six 8-exposure rolls	48003150	14.00
				Type 410 Polaroid Film, ASA 10,000 for 4520-A roll film adapter, carton of six 8-exposure rolls	48003190	14.00

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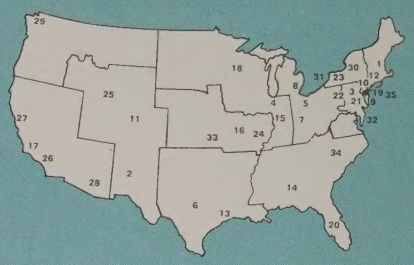

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